WisDOT Structural Engineers Symposium

Program Agenda
May 22, 2018

8:00 a.m. Registration

8:30 a.m. Welcome & BOS Director's Perspective – *Scot Becker*

8:45 a.m. Contract Plans & Fabrication Shop Drawing Review Changes – *Najoua Ksontini, Kristin Revello*

9:10 a.m. Wind Loaded Structures Initiative – *Andrew Smith, Mark Maday (CH2M/Jacobs)*

9:30 a.m. Removing Old Structure Over Waterways – *Bill Dreher*

9:45 a.m. Small Group (table) Discussion – *All*

10:00 a.m. Timeliness of Consultant Plan Submittals – *Najoua Ksontini*

10:15 a.m. Break (Beverages and Snacks)

10:35 a.m. Automation, Policy, and Standards – *Dave Kiekbusch, James Luebke*

11:15 a.m. Complex Structures – *Andrew Smith*

11:35 a.m. SCC Prestressed Girders – *Steve Doocy*

11:50 a.m. Lunch

12:50 p.m. Misc. Geotechnical/Structural Topics - *Jeff Horsfall (Bureau of Tech Services)*

1:20 p.m. BOS Overlay Policy, Marquette Interchange PPC Overlays – *James Luebke, Jason Sadowski (Michael Baker)*

1:50 p.m. 3D Design & Modeling, BIM for Structures – *Danielle DeTennis, Adam Swierczek*

2:05 p.m. I94 N-S – *Frank Pritzlaff (SE Region PM), Aaron Bonk*

2:35 p.m. Break (Beverages and Snacks)

2:55 p.m. Strengthening Program for Local Load Posted Bridges – *Alex Pence, Josh Dietsche*

3:20 p.m. Small Group (table) Discussion – *All*

3:35 p.m. Interactive Survey & Q/A

4:00 p.m. Adjourn

Conference Location: University of Wisconsin-Madison Union South
1308 West Dayton Street
Madison, WI 53715

For today's presentations, agenda, and proof of attendance, please visit:

http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/research.aspx

Welcome - 2018 Symposium

Scot Becker
BOS Director, State Bridge Engineer

2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

May 22, 2018

BUREAU OF STRUCTURES

Perspective Over View

- Welcome
- Agenda Highlight
  - What's new!
  - Continuing Progress

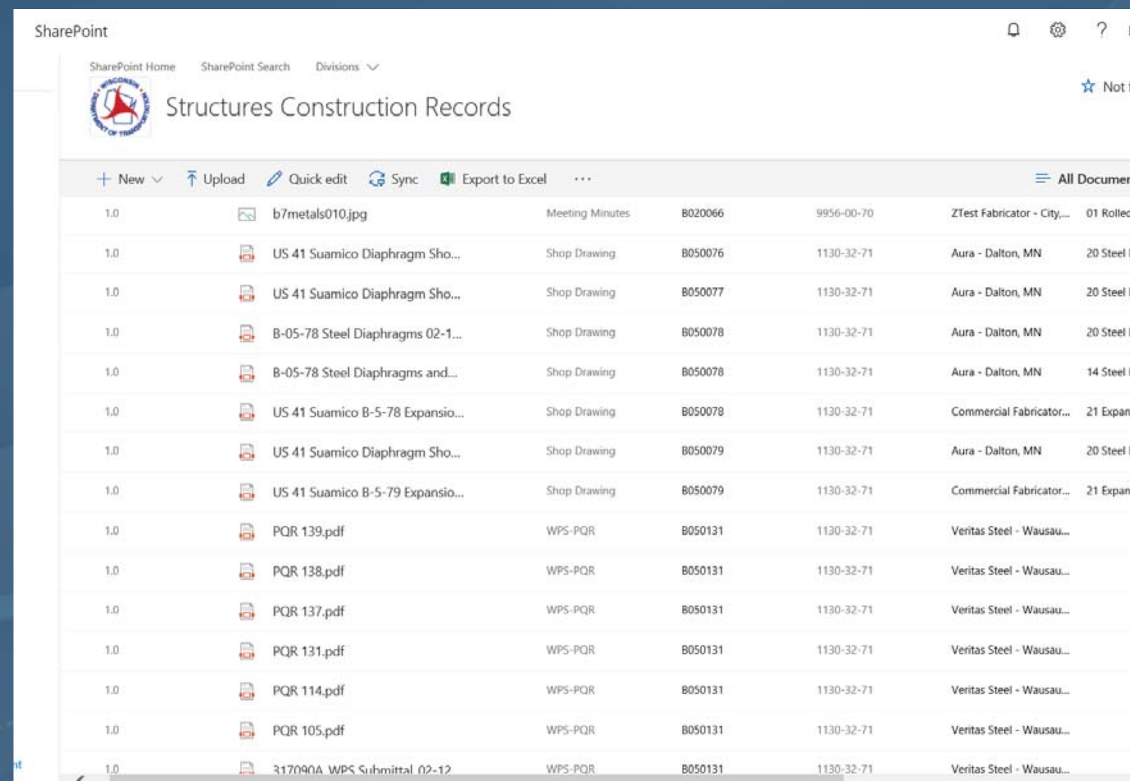
Todays Discussion - Focus Interactive

- Third Symposium – 2014,16,18

- Spend Time Today Discussing Issues, Clarifying Polices, Sharing Innovations, Questions or Concerns

What’s New – Fabrication Library

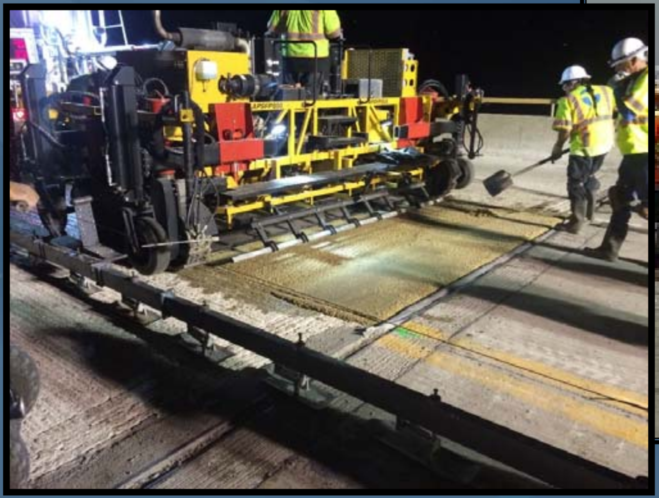
- New Fabrication Improved SharePoint Library Includes Ancillary Structures

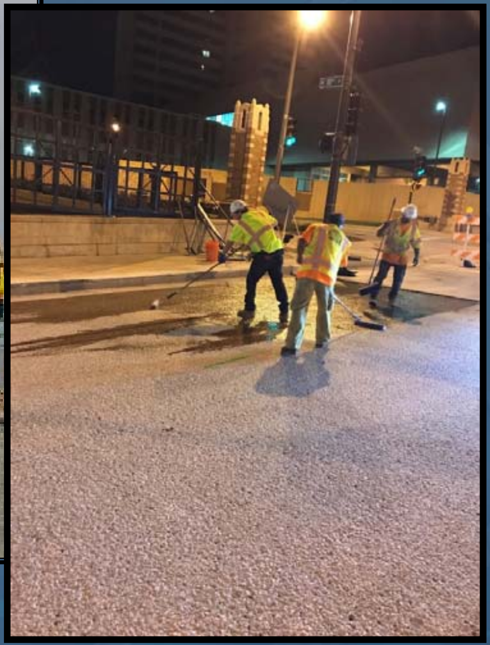


What’s New – SCC in Prestress Girders

- Self-Consolidating Concrete (SCC) for Prestressed Bridge Girders
- Moving Forward with SCC

What's New – Polyester Polymer Concrete (PPC) Overlay





What's New - LRFD Wind Loaded Structures

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What's New – St. Croix Bridge

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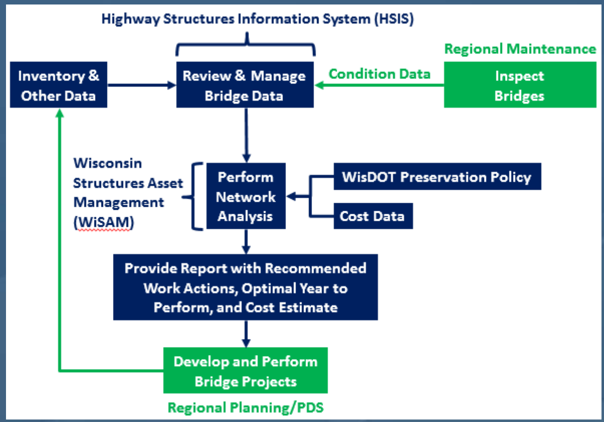
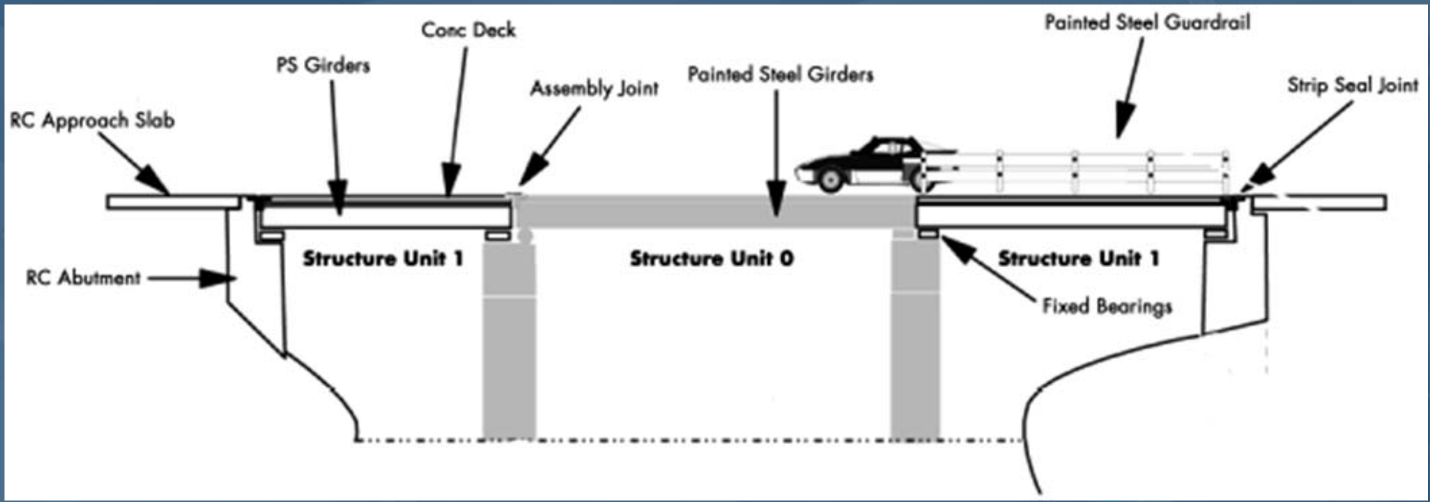
Highlight – Continued Progress

- Structures Asset Management
  - Program Generated by Element Condition
  - Emphasis on Preservation
  - Emphasis on Extending Serviceable Life

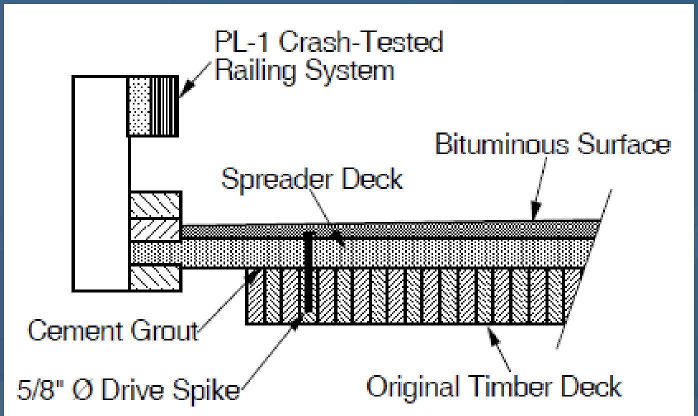


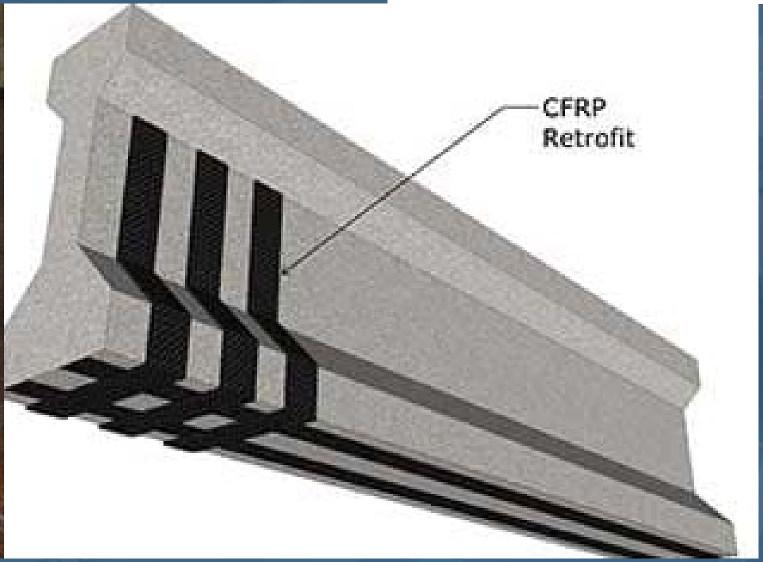


What's New – Local Bridge Program Changes

- Local Bridge Program Changes
- Fed State Money Swap
- Replace in Kind Policy
- Minimum Standards Based on Engineering Evaluation

What's New - Local Bridge Strengthening Program





Closing Request

I will repeat myself from 2016 if you recall ☺

- We want your Feedback and Input

- BOS - How are we doing?
- 4th Symposium?
- Innovations?
- Issues?

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Contract Plans- Review changes

Najoua Ksontini. P.E.
Consultant Review and Hydraulics Supervisor

2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

May 22, 2018

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- Goals of presentation
  - Discuss current plan submittal review process for various types of submittals and various types of structures
  - Discuss changes to review processes for various types of submittals and various types of structures

Stream Crossing and Grade Separation Preliminary Structure Plans

- No review process changes
  - All preliminary plan submittals are reviewed with focus on providing concurrence on Type, Size, and Location
  - Reviewers may provide comments on details contained on the preliminary plans
  - Contact BOS if you need input regarding proposed unusual and non-standard details

Stream Crossing and Grade Separation Final Structure Plans

- No review process changes
  - BOS will perform a Quality Assurance review on a select number of final structure plan submittals
  - Focus of BOS QA review is on structural design adequacy and load capacity
  - Reviewers may provide comments on structural details, constructability and biddability.
  - Contact BOS if you need input regarding proposed unusual and non-standard details

Rehabilitation Preliminary Structure Plans

- Review Process changes:
  - BOS will continue to provide comments on preliminary plans for the more complex rehabilitation work such as superstructure replacement, re-decks and joint replacement
  - BOS may not provide comments on preliminary plans for certain types of rehabilitation work such as painting and Polymer overlays
  - Designers will be notified if comments will not be provided

Rehabilitation Final Structure Plans

- Review Process changes:
  - BOS will continue to perform Quality Assurance reviews on a select number of final structure plan submittals for rehabilitation work
  - Contact BOS early if you need input regarding unusual and non-standard rehabilitation structural details

Retaining Wall Preliminary and Final Structure Plans

- Review Process changes:
  - BOS will provide comments only on a select number of retaining wall preliminary and final structure plans
  - Focus will be on non-proprietary retaining walls, plans with unusual or non-standard details and complex geometry
  - Designers will be notified if comments on preliminary plans will not be provided

Sign Structure Preliminary and Final Plans

- Review Process changes:
  - BOS will provide comments only on a select number of sign structure preliminary and final plans
  - Contact BOS if you need input regarding non-standard sign structure details

Questions?

Fabrication Shop Drawing Review & Process Changes

Kristin Revello, P.E.
Structural Metals and Fabrication QA Inspection Unit Supervisor

2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

May 22, 2018

BUREAU OF STRUCTURES

Presentation Goals

- To provide background on the Bureau of Structures Fabrication Initiatives
- Discuss the outcomes of each Fabrication Initiative, and highlight upcoming changes
- Address how these changes may affect you as designers of structures with fabricated items

Bureau of Structures Fabrication Initiatives

Overview

Tier 1

- Began Summer 2014
- Area of Focus
    - Steel Fabrication
- Creation of BOS Teams (Steering and Oversight)
- URS

Tier 2

- Began Winter 2017
- 4 Areas of Focus
    - Prestressed Concrete Girders
    - Retaining Walls
    - Sign Structures
    - Secondary Fabrication Items
- Creation of BOS Teams
- Michael Baker International

Bureau of Structures Fabrication Initiatives
Overview

- Interviews and Surveys were conducted regarding current processes, areas that worked well, and areas where improvements could be made
  - BOS staff
  - WisDOT region staff
  - Consultants
  - Fabricators
  - Steel Producers
  - Other state DOTs
- Other DOT specifications and processes were researched

Bureau of Structures Fabrication Initiatives
Overview

- For each area of focus, the current policy and practices were documented.
- Results of the interviews and surveys were documented, including current shop drawing review practices in other states
- A report for each initiative with findings and recommendations was created by the Consultant with input from the BOS Steering and Oversight Teams.
- Based on the report findings, BOS created an implementation plan for the outcomes that will be covered today.

Bureau of Structures Fabrication Initiatives

Tier 1 Outcomes

- The creation of the Contractor Certificate of Shop Drawing QC Form, DT 2333 for primary steel members.
  - Checklist based on Section 4 AASHTO/NSBA G1.1 Checklist Items
  - A P.E. is required to review the shop drawing and stamp the form, and a Contractor must sign certifying the review has occurred.
- The creation of the SharePoint Fabrication Library to receive steel shop drawings and fabrication documents
- The requirement of weekly Fabricator Progress Reports for primary steel members
- A reduction in the percentage of steel shop drawing reviews performed

Bureau of Structures Fabrication Initiative

Tier 2 Outcomes

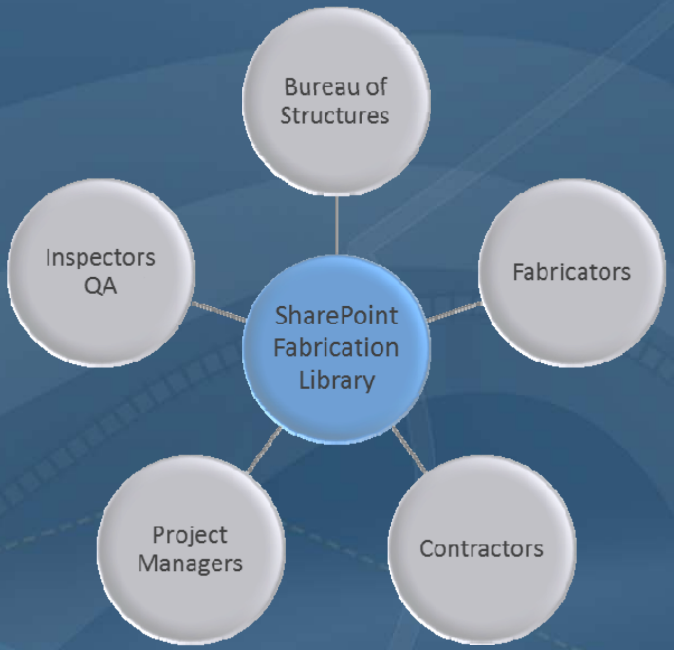
WisDOT Fabrication Quality Assurance Program

Program Goal: To consistently enforce submittal of required documentation and enact Quality Assurance

- Provide electronic submittal requirements for fabrication documents
- Provide guidance for roles and responsibilities for all parties involved
- Ensure department quality assurance and contractor quality control roles
- Modify standard specifications and CMM for clarity and enforcement
- Clarify approved fabricator requirements

The WisDOT Fabrication Library Expansion

The Goal: A single comprehensive library for the submittal of all fabrication documents, accessible to all parties (as appropriate).



In March 2018, the new Fabrication Library went live for our users.

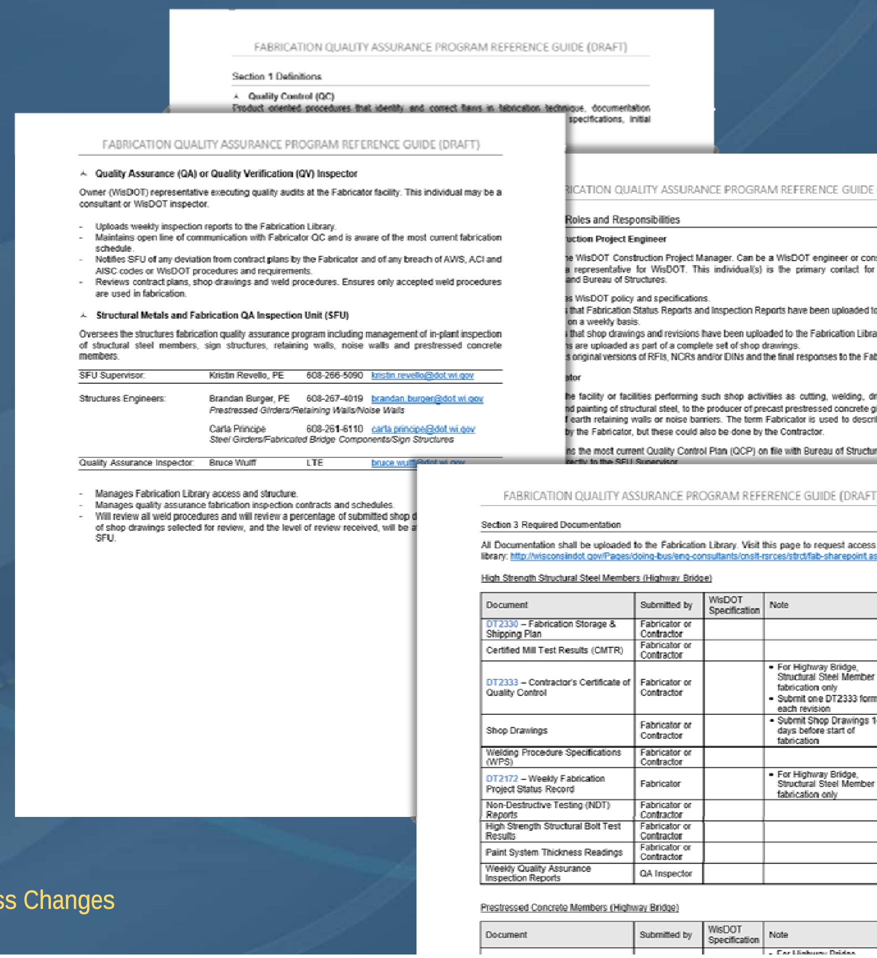
For December 2018 Let and beyond, this will be the mechanism to receive all structure shop drawings and fabrication documents.

Roles and Responsibilities - Reference Guide

Fabrication QA Program
Reference Guide

- Definitions
- Roles & Responsibilities
- SFU Contact Information
- Required Documentation by Structure Type
- Standard Specification References

Is available on the fabrication and Quality Assurance website, and will be referenced in the CMM


FABRICATION QUALITY ASSURANCE PROGRAM REFERENCE GUIDE (DRAFT)

Section 1 Definitions

- Quality Control (QC)

FABRICATION QUALITY ASSURANCE PROGRAM REFERENCE GUIDE (DRAFT)

- **Quality Assurance (QA) or Quality Verification (QV) Inspector**

Owner (WisDOT) representative executing quality audits at the Fabricator facility. This individual may be a consultant or WisDOT inspector.

- Uploads weekly inspection reports to the Fabrication Library.
- Maintains open line of communication with Fabricator QC and is aware of the most current fabrication schedule.
- Notifies SFU of any deviation from contract plans by the Fabricator and of any breach of AWS, ACI and AISC codes or WisDOT procedures and requirements.
- Reviews contract plans, shop drawings and weld procedures. Ensures only accepted weld procedures are used in fabrication.

- **Structural Metals and Fabrication QA Inspection Unit (SFU)**

Oversees the structures fabrication quality assurance program including management of in-plant inspection of structural steel members, sign structures, retaining walls, noise walls and prestressed concrete members.

SFU Supervisor:	Kristin Revello, PE	608-266-5090	kristin.revello@dot.wi.gov
Structures Engineers:	Brandan Burger, PE *Prestressed Girders/Retaining Walls/Noise Walls*	608-267-4019	brandan.burger@dot.wi.gov
	Carla Principe *Steel Girders/Fabricated Bridge Components/Sign Structures*	608-261-6110	carla.principe@dot.wi.gov
Quality Assurance Inspector:	Bruce Wulff	LTE	

- Manages Fabrication Library access and structure.
- Manages quality assurance fabrication inspection contracts and schedules.

FABRICATION QUALITY ASSURANCE PROGRAM REFERENCE GUIDE (DRAFT)

Section 3 Required Documentation

High Strength Structural Steel Members (Highway Bridge)

Document	Submitted by	WisDOT Specification	Note
DT2330 – Fabrication Storage & Shipping Plan	Fabricator or Contractor		
Certified Mill Test Results (CMTR)	Fabricator or Contractor		
DT2333 – Contractor's Certificate of Quality Control	Fabricator or Contractor		• For Highway Bridge, Structural Steel Member fabrication only • Submit one DT2333 form for each revision
Shop Drawings	Fabricator or Contractor		• Submit Shop Drawings 14 days before start of fabrication
Welding Procedure Specifications (WPS)	Fabricator or Contractor		
DT2172 – Weekly Fabrication Project Status Record	Fabricator		• For Highway Bridge, Structural Steel Member fabrication only
Non-Destructive Testing (NDT) Reports	Fabricator or Contractor		
High Strength Structural Bolt Test Results	Fabricator or Contractor		
Paint System Thickness Readings	Fabricator or Contractor		
Weekly Quality Assurance Inspection Reports	QA Inspector		

Prestressed Concrete Members (Highway Bridge)

Document	Submitted by	WisDOT Specification	Note

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QA vs QC

- Although the Department intended to perform QA review of shop drawings, the reality was that we were performing QC in many areas.
  - We reviewed 100% of shop drawings
  - In some cases we were correcting errors, and essentially performing QC for the fabricator and contractor
- The decision was made to realign our processes with QA
  - Reducing the percentages of Department review
  - Look to place the responsibility of shop drawing QC on the contractor and fabricator

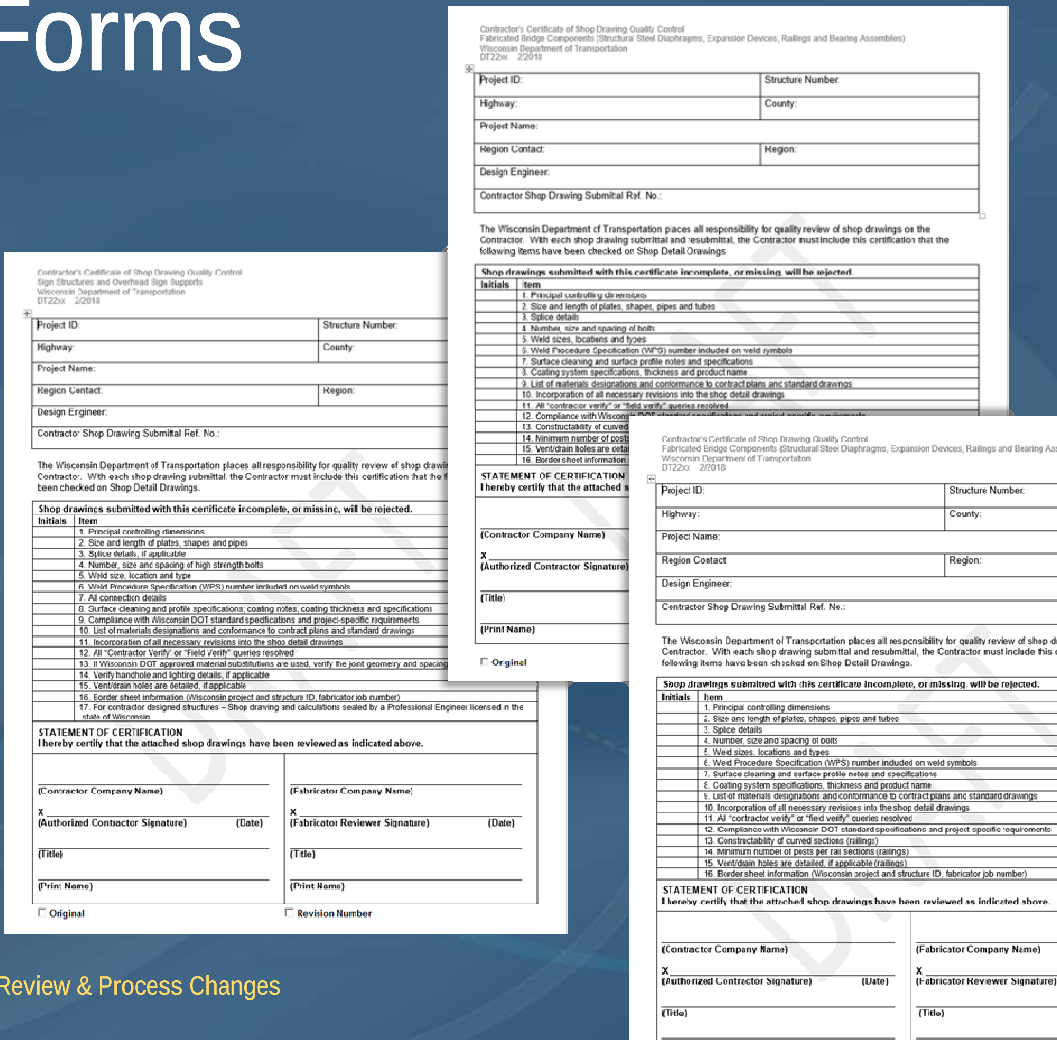
QA vs QC

- The Bureau of Structures has notified WTBA that we will no longer be reviewing all shop drawings.
- The percentages of review, and criteria of selection for each type of shop drawing will be determined by BOS.
- Project staff will be notified when a shop drawing has been selected for review.
- In the Fabrication Library, there is shop drawing status flag to indicate whether the shop drawing has been selected for review, if was reviewed and it needs to be resubmitted, or if it has been accepted.

Contractor Certificate of Shop Drawing QC Draft Forms

- Sign Structures and Overhead Sign Supports
- Retaining Walls
- Fabricated Bridge Components
- Prestressed Concrete Girders
  - Mesh substitutions are still being evaluated

Check lists are based on commonly found errors on shop drawings



Modified WisDOT Approved Fabricator List

2018 Standard Specification List: Bridge Metal Secondary Fabrication Item

Secondary fabrication items are defined as:

Rail Posts	**Curb and sidewalk cover plates**
Sleeves	**Floor drains**
Shims	**Guard rail anchors**
Rail panels	**Sheet Lead**
Anchor Bolts	**Non-Laminated Elastomeric pads**
Protection Angles	***(see "Laminated Elastomeric Bearings" list for those items)***
Structural Fasteners	**Bearing assemblies(steel)**
Expansion Devices	**Structural steel diaphragms**

APPROVED FABRICATORS, BRIDGE METAL SECONDARY FABRICATION

Date last edited: 12/21/2017

Approved Fabricator	Location
Aura Fabricators [2]	14122 Norway Pine Dalton, MN 56324 218-589-7121
Camelot Metals Inc.	3100 82nd Ln NE, B (651) 636-3450
Commercial Fabricators	Bridgeview, IL
CON-SERV Inc.	2963 Interstate Pkw Brunswick, OH 442
Badger Railing	Milwaukee, WI
D.S. Brown(Lewis Engineering Division)	Chaska, MN
ESPO Engineering	845 Midway Dr. Willowbrook , IL 60 630-789-2525
ESS Brothers	Minneapolis, MN
IronWorks (Synergies, LLC)	PO Box 620 13995 Industry Ave Becker, MN 55308 763-262-4760
Janke General Contractors, Inc.	1223 River View La Athens, WI 54411 Phone: 715.257.790
PACAL, LLC (Paper Calumensen) REMOVED FROM LIST 3/24/2015	St. Paul, MN
LienTec, Inc. [1] REMOVED FROM LIST 3/24/2015	1000 East Street Stoughton, WI 535 608-877-5887
Tobi Engineering, Inc.	3126 W. Lake Ave. Glenview, IL 60026 847-724-7880
Utility Sales and Supply, Inc.	23230 West Thome Loretto, MN 55357 612-385-7529
Van Lanen Mfg., Inc.	5335 STH 29 Denmark, WI 5420 920-863-5705
Viking Steel Inc.	Oshkosh, WI

Modified WisDOT Approved Fabricator List

2019 Standard Specification List: Fabricated Bridge Components

- Railings
- Bearings
- Expansion Devices
- Structural Steel Diaphragms

APPROVED FABRICATORS, RAIL ASSEMBLIES

Date last edited: XX/XX/2017

Approved Fabricator	Location	Phone Number	Approval Date
Aura Fabricators	14122 Dieseth Rd Dalton, MN 56324	(218) 589-7121	

APPROVED FABRICATORS, BEARINGS

Date last edited: XX/XX/2017

Approved Fabricator	Location	Phone Number	Approved Products	Approval
Bridge Components Ind.	3476 Millikin Court Columbus, OH 43228	(614) 873-0777	1	11/28/20

APPROVED FABRICATORS, EXPANSION DEVICES

Date last edited: XX/XX/2017

Approved Fabricator	Location	Phone Number	Approved Products	Approval
Camelot Metals, Inc.	2501 County Road B West St. Paul, MN 55113	(651) 636-3450		

APPROVED FABRICATORS, STRUCTURAL STEEL DIAPHRAGMS

Date last edited: XX/XX/2017

Approved Fabricator	Location	Phone Number	Approval Date
Camelot Metals, Inc.	2501 County Road B West St. Paul, MN 55113	(651) 636-3450	
Commercial Fabricators	7247 S 78th Ave Bridgeview, IL 60455	(708) 594-1199	
D.S. Brown (Lewis Engineering Division)	4201 Nortex Dr Chaska, MN 55318	(952) 368-3000	

Note:

1) For policy on acceptance/removal from the approved products list, please see:

Status Options

New WisDOT Approved Fabricator Lists

Effective with the 2019 Standard Specification

- WisDOT will be creating 2 new Approved Fabricator Lists
  - Primary Steel Members
  - Sign Structures and Overhead Sign Supports
- In order to fabricate these items, the fabricator will need to be on the appropriate APL prior to the Let.
- Fabricator requirements to be added to these lists and the application & renewal process will be clearly defined for all parties.

Fabrication Progress Reports

- The weekly requirement of Fabrication Progress Reports submitted to the Fabrication Library for prestressed girders, fabricated bridge components, sign structures, and overhead sign supports

This form shall be submitted to the Fabrication Library on a weekly basis. Create additional lines as needed.

Shop drawings, revisions to shop drawings, RFIs and NCRs must be submitted to the Fabrication Library

If you don't have access to the Fabrication Library click here to apply for an account

I certify to the best of my knowledge that the information below is correct.

X 5/12/2018

(Fabricator's QC Manager – E-Signature) *Today's Date*

Week Ending	mm/dd/yyyy (Saturday)
Fabricator	Company Name
QC Manager	First Last Name

Shop drawings, revisions to shop drawings, RFIs and NCRs must be submitted to the Fabrication Library

PROJECT ID	STRUCTURE ID	JOB NUMBER	FABRICATED COMPONENT	MATERIAL AT SHOP FLOOR		CUTTING		WELDING		ASSEMBLY		SURFACE PREPARATION		@ GALVANIZER OR PAINTER		SHIPPED	
XXXX-XX-XX	X-XX-XXX	XXXXXXX	Select from dropdown menu	Date Delivery Anticipated mm/dd/yy	Date Delivered mm/dd/yy	Date Started/ Anticipated mm/dd/yy	Date Completed mm/dd/yy	Date Started/ Anticipated mm/dd/yy	Date Completed mm/dd/yy	Date Started/ Anticipated mm/dd/yy	Date Completed mm/dd/yy	Date Started/ Anticipated mm/dd/yy	Date Completed mm/dd/yy	Date Shipped mm/dd/yy	Date Returned mm/dd/yy	Anticipated Date mm/dd/yy	Date Shipped mm/dd/yy

Upcoming Changes to Retaining Wall SPVs

For the August 1st 2018 PSE

- Changes will include updates to retaining wall system preapproval process information
- Added requirement of Contractor Certificate of Shop Drawing QC for retaining walls
- Adding requirement for Fabrication Library Submittal
- Updated SPVs to be available prior to June 1st for inclusion in August 2018 PSE projects

DELETE ALL DESIGNER NOTES FROM YOUR SPECIAL PROVISIONS
Recommended PPQ item. Please indicate PPQ in the project estimate.

Wall Concrete Panel Mechanically Stabilized Earth (structure), Item SPV.0165.XX

A. Description
This special provision describes designing, furnishing materials and erecting a permanent earth retention system in accordance to the lines, dimension, elevations and details as shown on the plans and provided in the contract. The design life of the wall and all wall components shall be 75 years minimum.

This special provision describes the quality management program (QMP) for Mechanically Stabilized Earth (MSE) walls. A quality management program is defined as all activities, including process control, inspection, sampling and testing, and necessary adjustments in the process that are related to the construction of the MSE wall, which meets all the requirements of this provision.

This special provision describes contractor quality control (QC) sampling and testing for backfill density testing, documenting those results, and documenting related production and placement process changes. This special provision also describes department quality verification (QV), independent assurance (IA), and dispute resolution.

Chapter 8 of the department's construction and materials manual (CMM) provides additional detailed guidance for QMP work and describes sampling and testing procedures.

B. Materials
B.1 Proprietary Wall Systems
The supplied wall system must be from the department's approved list of Concrete Panel Mechanically Stabilized Earth Wall systems. Proprietary wall systems must conform to the requirements of this specification and be pre-approved for use by the department's Bureau of Structures. The department maintains a list of pre-approved proprietary wall systems. The name of the pre-approved proprietary wall system selected shall be furnished to the engineer within 25 days after the award of contract.

To be eligible for use on this project, a system must have been pre-approved by the Bureau of Structures and added to that list prior to the bid opening date. To receive pre-approval, the retaining wall system must comply with all pertinent requirements of this provision and be prepared in accordance to the requirements of Chapter 14 of the department's LRFD Bridge Manual. Information and assistance with the pre-approval process can be obtained by contacting the Bureau of Structures, Structures Maintenance Section in Room 601 of the Hill Farms State Transportation Building in Madison or by calling (608) 266-8494.

B.2 Design Requirements

2019 Standard Specification
Upcoming Changes

- Working to remove cross-referencing across the structure sections, eliminating conflicts
  - Unique requirements (Such as DT2333 for primary steel members) will be included in the specific structure section
  - Under 105.2 Supplemental Plans and Drawings, adding guidance regarding Fabrication Library Submittal Requirements
- Added requirement of Contractor Certificate of Shop Drawing QC
- Requirement of weekly Fabrication Progress Reports

2019 Standard Specification
Upcoming Changes

- Added clarification in 506.3.1 regarding steel primary members
- Renamed secondary fabricated items "fabricated bridge components" and revised definition
- Requirements to use an approved fabricator from the Department's APL for primary members, sign structures, and overhead sign supports

The Importance of Designer QA/QC
“The Big Picture”

- Consultant Review Unit
  - Performs QA reviews on a percentage of the design plans we receive
- Structural Metals and Fabrication QA Inspection Unit
  - Performs QA reviews on a percentage of the shop drawings we receive

There is a possibility that your design plan and the associated shop drawings may not be reviewed. Any plan errors may not be caught.

The Importance of Designer QA/QC

“The Big Picture”

- RFIs will be the mechanism for the Contractor and Fabricator to clarify possible issues with design plans
- There is a potential increased chance of Errors and Omissions
- Keeping this in mind when preparing design plans, and following your firm’s QA/QC plan will help you avoid any potential issues

Questions?

Wind Loaded Structures Initiative

Andrew Smith/WisDOT
Mark Maday/Jacobs

WisDOT Structural
Engineers Symposium
May 22, 2018

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JACOBS ch2m

Wind Loaded Structure Initiative

- Primary Purpose
  - Transition to LRFD
- While we are at it
  - Process improvement
- Current Challenges
  - Multiple processes but one design spec.
  - Getting plans in HSI

Wind Loaded Structure Initiative

- Wind Loaded Structures Include:
  - Sign Bridge, Cantilever and Butterfly Sign Structures
  - Overhead Sign Supports
  - High Mast Lighting
  - Associated Support Foundations and Anchorages

- Phase 1 - Evaluation:
  - Evaluating Process, Policy, Standards, and Specifications
  - Develop Recommendations for Improvements and Updates
  -

Wind Loaded Structure Initiative

Phase 2 - Implementation

Goals and Anticipated Work Products:

- Clarified / Updated Process
- Increased Uniformity / Consistency
- Transition to LRFD Design
- Design Manual Updates (BM, FDM, CIM)
- Specification Updates (Standard Specifications and / or STSPs)

–

Team

WisDOT Work Group:

- Andrew Smith – PM Andrew.Smith@dot.wi.gov
- Alexander Crabtree – Design Alexander.Crabtree@dot.wi.gov
- Steve Doocy – Design Steve.Doocy@dot.wi.gov
- Jeff Horsfall – Geotechnical Jeffrey.Horsfall@dot.wi.gov
- David Nelson – Development David1.Nelson@dot.wi.gov
- William Oliva – Oversite William.Oliva@dot.wi.gov
- Carla Principe – Fabrication Carla.Principe@dot.wi.gov
- Matt Rauch – Traffic Ops Matt.Rauch@dot.wi.gov
- Vu Thao – Design Vu.Thao@dot.wi.gov

Team

Jacobs:

Mark Maday Mark.Maday@Jacobs.com

Karl Schmid Karl.Schmid@jacobs.com

Schedule

Kick-Off: June 2017

Phase 1 Completion: August 2017

- Evaluation of Current Process
- Stakeholder Outreach
- Evaluation of Other DOT Processes
- Develop Recommendations:
  - Improving Uniformity
  - General Standards Updates
  - Transition to LRFD Design
  - Specification Updates
  - Design Software

Schedule

Phase 2 Completion: June 2019

- Design Manual Updates
- Revised Standard Detail Drawings and Insert Sheets
- Standard Specifications, STSP Updates
- Outreach and Training Presentations

Tasks & Progress to Date

Review of Current Process:

- Solicited Input from All WisDOT Regions and Central Office
- Identify What Works; Best Practices
- Identify Areas for Improvement

Tasks & Progress to Date

Stakeholder Outreach:

- Solicited Input From:
  - Sign Structures Suppliers / Fabricators
  - Contractors
  - DOT Designers (BOS)
  - Consultant Designers

Tasks & Progress to Date

Review of Other State DOT's:

Received Input from 10 State DOTs:

Florida, Indiana, Iowa, Michigan, Utah, Texas

North Dakota, Michigan, Virginia, Washington

Three States Using LRFD for Sign Structure Design:

Minnesota, Florida, Washington

Tasks & Progress to Date

Initial Recommendations:

Revised / Improved Process

- Clarify Process
- Emphasize Follow Through / Completing All Steps

Improving Uniformity

- Clarification / Concise Direction In BM
- Consistency Between Manuals, Standards and Specifications

General Standard Updates

- Standard for Each Structure Type
- Include Foundations

Current / Upcoming Activity

Recommendations:

- Transition to LRFD Design
- Specification Updates
- Design Software

Phase 1 Completion - Summary Report

It's Not Too Late!

We Welcome Your Input…

- Any Ideas, Comments or Suggestions?
- Contact Andrew or Any Member of the Work Group

Andrew Smith / WisDOT

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Email: Andrew.Smith@dot.wi.gov

Mark Maday / Jacobs

Cell: (414) 975-6129
Email: Mark.Maday@Jacobs.com

Thank You

Questions?

Removing Old Structure Over Waterway

Bill Dreher, P.E.

Structures Design Chief

2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

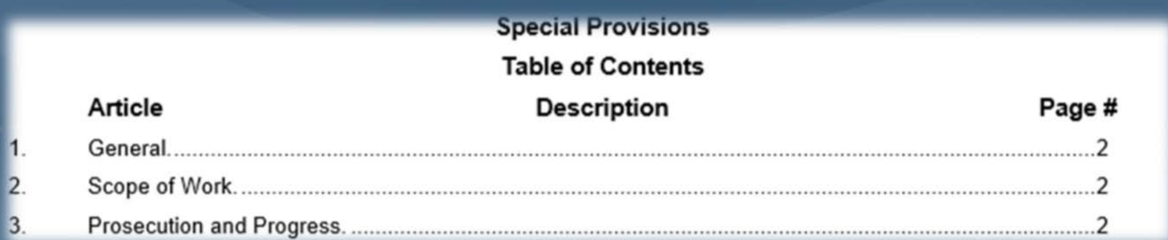
May 22, 2018

BUREAU OF STRUCTURES

- What are the options?
- What are the differences?
- What are the costs?
- How do I choose?

What are the options?

- Standard Specification
- + 3 choices with varying levels of restrictions



Special Provisions

Table of Contents

Standard Specification

- Section 203 Removing Old Culverts and Bridges
  - 203.3.2.2 Removal Operations:
    Minimize debris falling onto water surfaces and wetlands as the contract specifies in 107.18 or in the special provisions.

Standard Specification

- Section 107 Legal Relations and Responsibility to the Public
  - 107.18 Environmental Protection:
    Take all necessary precautions to prevent pollution of streams…
    Conduct work operations to avoid or minimize siltation of streams…
    Remove existing structures in large pieces, minimizing the number of smaller pieces that drop into the water. Remove all steel and all concrete pieces or other debris larger than 5 inches.

Standardized Special Provisions (STSP's)

- Designer should coordinate with regional environmental coordinator and DNR to reach consensus on which special to use for the removal.

Standardized Special Provisions (STSP's)

- The lowest level of care is for situations where there is little choice but to drop the structure into the waterway.
- The highest level of care requires a debris capture system to prevent virtually all debris from falling into the waterway.

Standardized Special Provisions (STSP's)

- STSP 203-015: Removing Old Structure Over Waterway
  - Use this special provision where it is not possible to remove the structure without dropping it, or a portion of it, into a waterway or wetland; and that waterway or wetland is not highly environmentally sensitive.

Standardized Special Provisions (STSP's)

- STSP 203-015: Removing Old Structure Over Waterway
  - This special provision is typically appropriate for removing the following structure types:
    - Slab spans, voided slabs
    - Cast-in-place girder bridges
    - Earth-filled bridges
    - Some large trestle bridges

Standardized Special Provisions (STSP's)

- STSP 203-015: Removing Old Structure Over Waterway
  - Remove all reinforcing steel, all concrete, and all other debris that falls into the waterway or wetland.
  - Remove large pieces of the structure within 36 hours.
  - The contractor may leave limited amounts of small concrete pieces scattered over the waterway floor or wetland only if the engineer allows.

Standardized Special Provisions (STSP's)

- STSP 203-020: Removing Old Structure Over Waterway With Minimal Debris
  - Use this special provision where it is possible to remove the structure without dropping it, or a portion of it, into a waterway or wetland; and that waterway or wetland is not highly environmentally sensitive.

Standardized Special Provisions (STSP's)

- STSP 203-020: Removing Old Structure Over Waterway With Minimal Debris
  - This special provision is typically appropriate for removing all structures types except for the following:
    - Slab spans, voided slabs
    - Cast-in-place girder bridges
    - Earth-filled bridges
    - Some large trestle bridges

Standardized Special Provisions (STSP's)

- STSP 203-020: Removing Old Structure Over Waterway With Minimal Debris
  - This special provision will likely be used for most removals.

Standardized Special Provisions (STSP's)

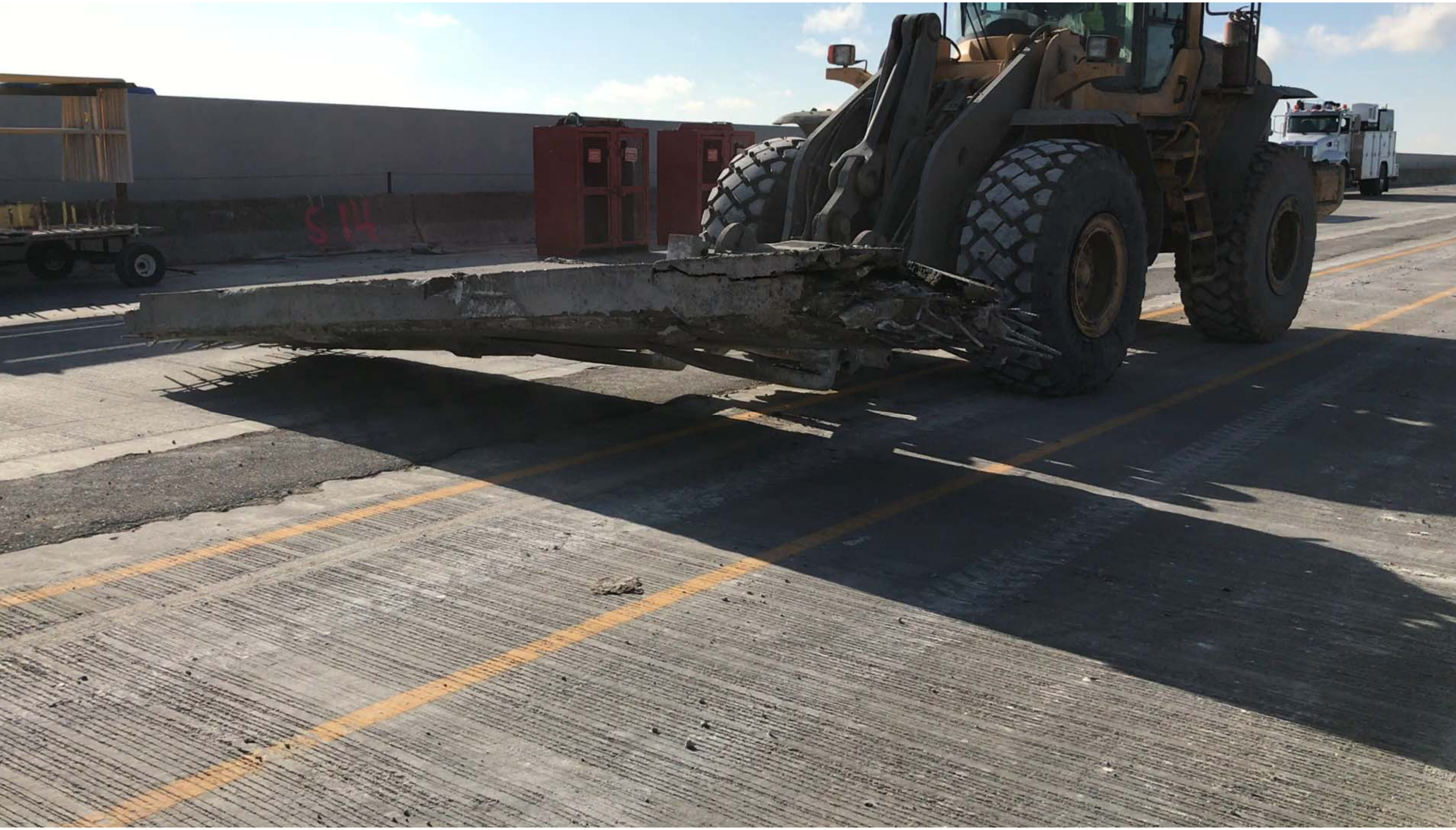
- STSP 203-020: Removing Old Structure Over Waterway With Minimal Debris
  - Remove the existing structure in large sections.
  - Prevent all large pieces and minimize the number of small pieces from entering the waterway or wetland.

Standardized Special Provisions (STSP's)

- STSP 203-020: Removing Old Structure Over Waterway With Minimal Debris
  - Remove all reinforcing steel, all concrete, and all other debris that falls into the waterway or wetland.
  - The contractor may leave limited amounts of small concrete pieces scattered over the waterway floor or wetland only if the engineer allows.


VOLVO
VOLVO
EC460CL


LUNDA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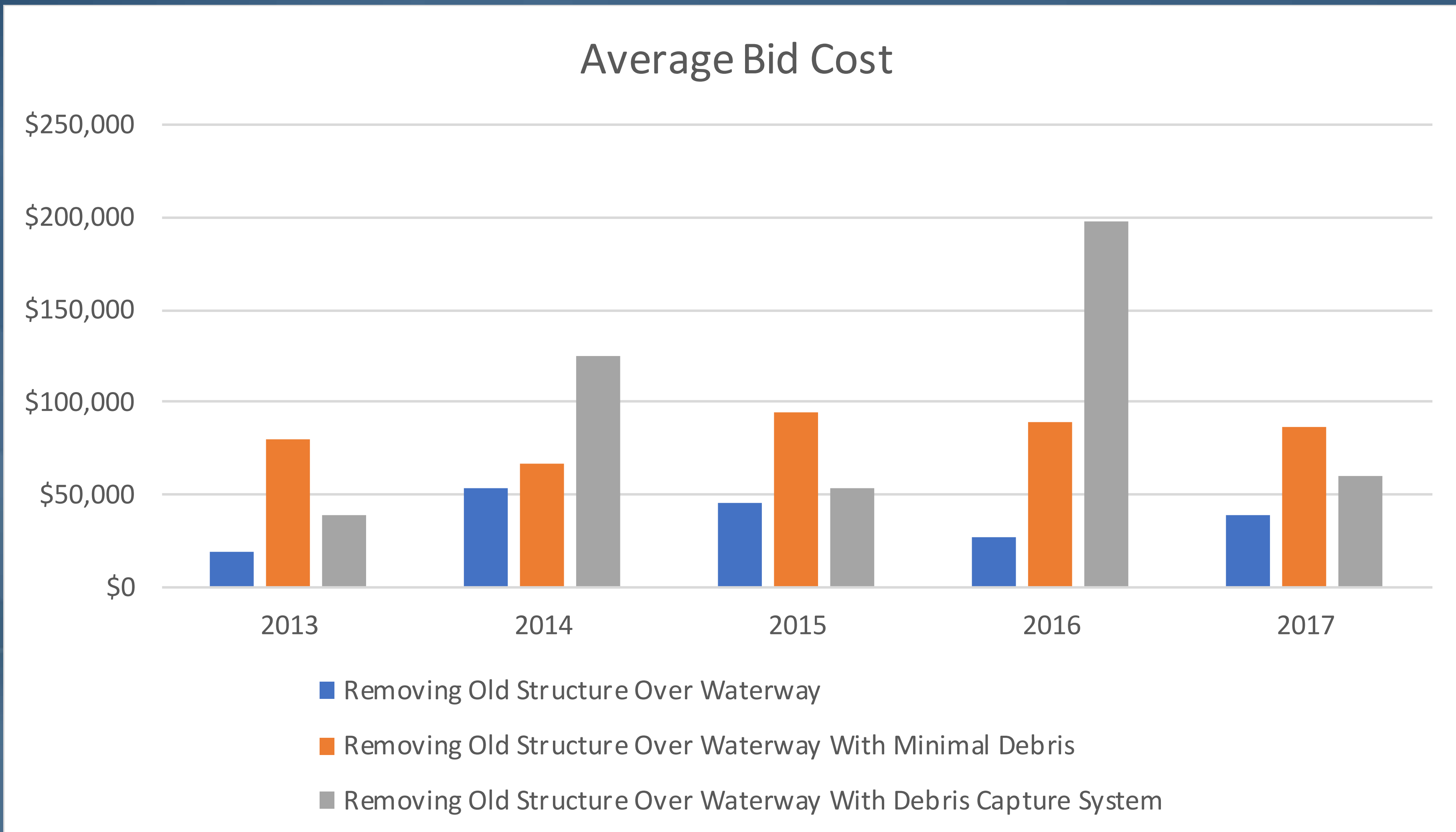
Standardized Special Provisions (STSP's)

- STSP 203-025: Removing Old Structure Over Waterway With Debris Capture System
  - Consider using this special provision where a waterway or wetland is highly environmentally sensitive.
  - Consult with the department's regional environmental coordinator to determine if the affected waterway or wetland is highly environmentally sensitive and if this special provision is appropriate.

Standardized Special Provisions (STSP's)

- STSP 203-025: Removing Old Structure Over Waterway With Debris Capture System
  - Remove the existing structure in large sections.
  - Due to the very sensitive nature of the waterway name, provide a debris capture and containment system that prevents all large pieces and virtually all other debris, including fine particles and slurry, from entering the waterway or wetland.

	STSP 203-015 Removing Old Structure Over Waterway	STSP 203-020 Removing Old Structure Over Waterway With Minimal Debris	STSP 203-025 Removing Old Structure Over Waterway With Debris Capture System
Environmental Sensitivity of waterway	Not high	Not high	High
Allowable Debris		Prevent all large pieces and minimize the number of small pieces from entering the waterway or wetland	Prevent all large pieces and virtually all other debris, including fine particles and slurry, from entering the waterway or wetland.
	Remove all reinforcing steel, all concrete, and all other debris that falls into the waterway or wetland.	Remove all reinforcing steel, all concrete, and all other debris that falls into the waterway or wetland.	
	Remove large pieces of the structure within 36 hours.		
	May leave limited amounts of small concrete pieces scattered over the waterway floor or wetland only if the engineer allows	May leave limited amounts of small concrete pieces scattered over the waterway floor or wetland only if the engineer allows	
Removal Restrictions		Remove in large sections	Remove in large sections
Applicable Structure Type	Where it is not possible to remove the structure without dropping it	Where it is possible to remove the structure without dropping it, or a portion of it, into a waterway or wetland	
	For removing slab spans; voided slabs; cast-in-place girder bridges; earth-filled bridges; large trestle bridges.	For removing all structures types except for slab spans; voided slabs; cast-in-place girder bridges; earth-filled bridges; large trestle bridges.	


Average Bid Cost
$250,000
$200,000
$150,000
$100,000
$50,000
$0
2013
2014
2015
2016
2017
Removing Old Structure Over Waterway
Removing Old Structure Over Waterway With Minimal Debris
Removing Old Structure Over Waterway With Debris Capture System

How Do I Choose?

- Review all 3 specials and coordinate with regional environmental coordinator and DNR to reach consensus on which special to use for the removal.
- The special provision language is intended to be a reasonable starting point; however, it may need to be expanded to address additional DNR or other concerns.

How Do I Choose?

- For unique or difficult removals, consult with the contracting community to assess costs and the feasibility of a particular removal technique.
- Consult with the department's regional environmental coordinator to determine if the affected waterway or wetland is highly environmentally sensitive and which special provision is appropriate.
- Don’t make the decision w/o good information!

Questions?

Timeliness of Consultant Plan Submittals

Najoua Ksontini, P.E.
Consultant Review and Hydraulics Supervisor

2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

May 22, 2018

BUREAU OF STRUCTURES

BOS Plan Submittal Timeline Expectations

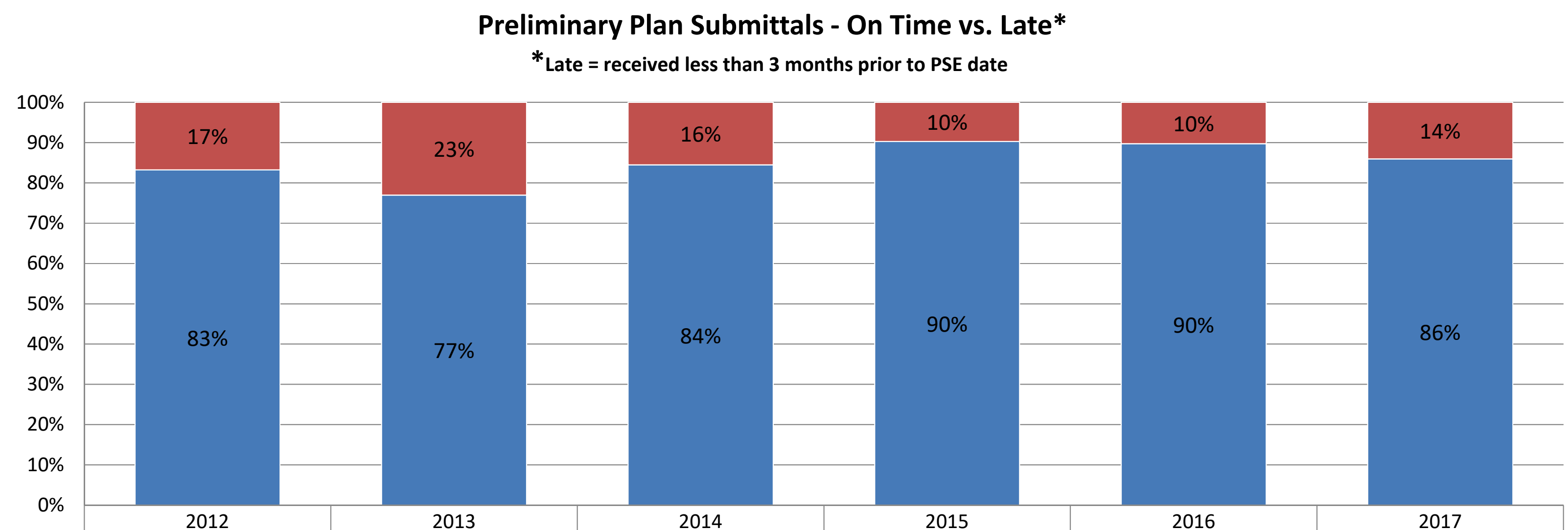
- Preliminary Structure Plans:
  - Project schedule should allow for a minimum of 60 days for BOS review. Adequate time for comment resolution, design, and final plan preparation prior to final plan submittal will determine the date that preliminary plans need to be submitted.
  - For the purpose of tracking, BOS considers preliminary plan submittals to be late if received less than 3 months prior to the PS&E date.

BOS Plan Submittal Timeline Expectations

- Final Structure Plans:
  - BOS requires that final structure plans, structural computations, and other pertinent documents are submitted 2 months prior to project PS&E date

Trends in Preliminary Plans Submittal Timeliness

Includes all types of structures: bridges, culverts , retaining walls, and sign structures

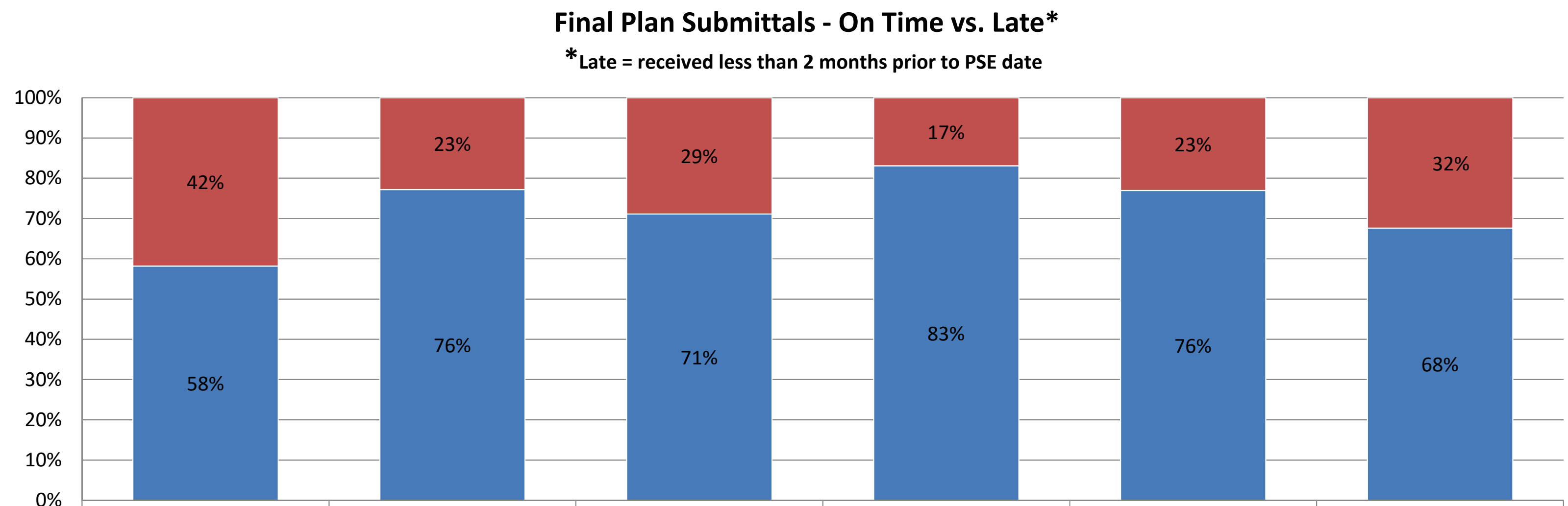


	2012	2013	2014	2015	2016	2017
Late	47	106	64	31	33	72
On Time	233	354	348	288	288	441
Total	280	460	412	319	321	513

BUREAU OF STRUCTURES

Trends in Final Structure Plans Submittal Timeliness

Includes all types of structures: bridges, culverts , retaining walls, and sign structures

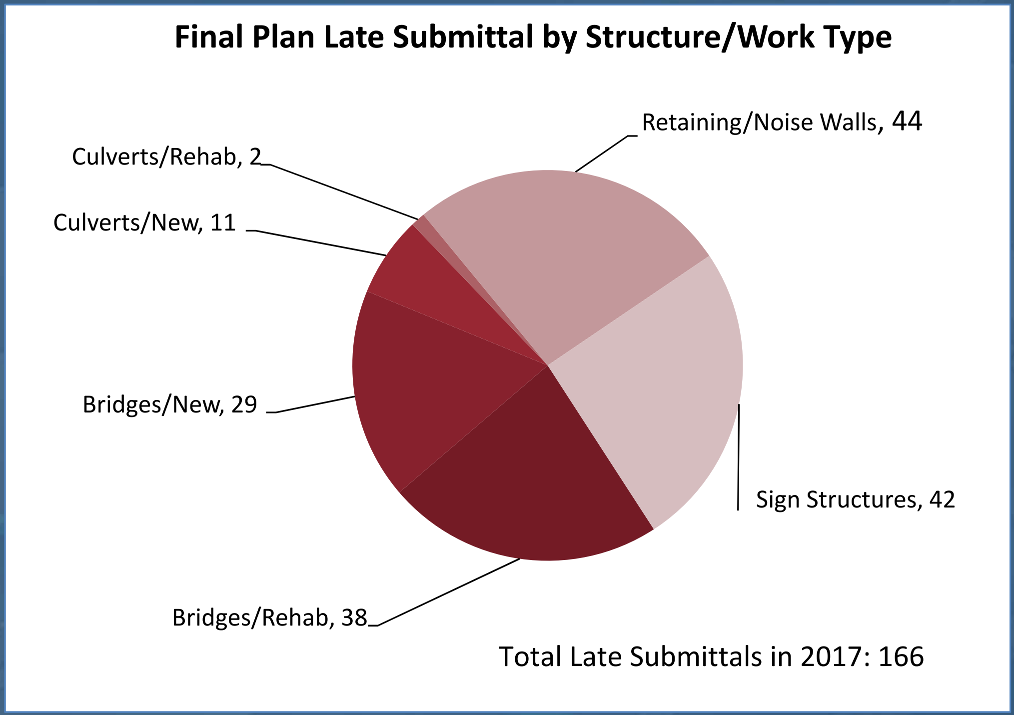


	2012	2013	2014	2015	2016	2017
Late	117	105	119	54	74	166
On Time	163	355	293	265	247	347
Total	280	460	412	319	321	513

BUREAU OF STRUCTURES

Late Final Plan Submittals by Structure Type

- In 2017, about 166 late final structure plan submittals.
- Evenly divided:
  - new bridges or culverts.
  - rehabilitation bridges or culverts.
  - retaining walls.
  - sign structures.



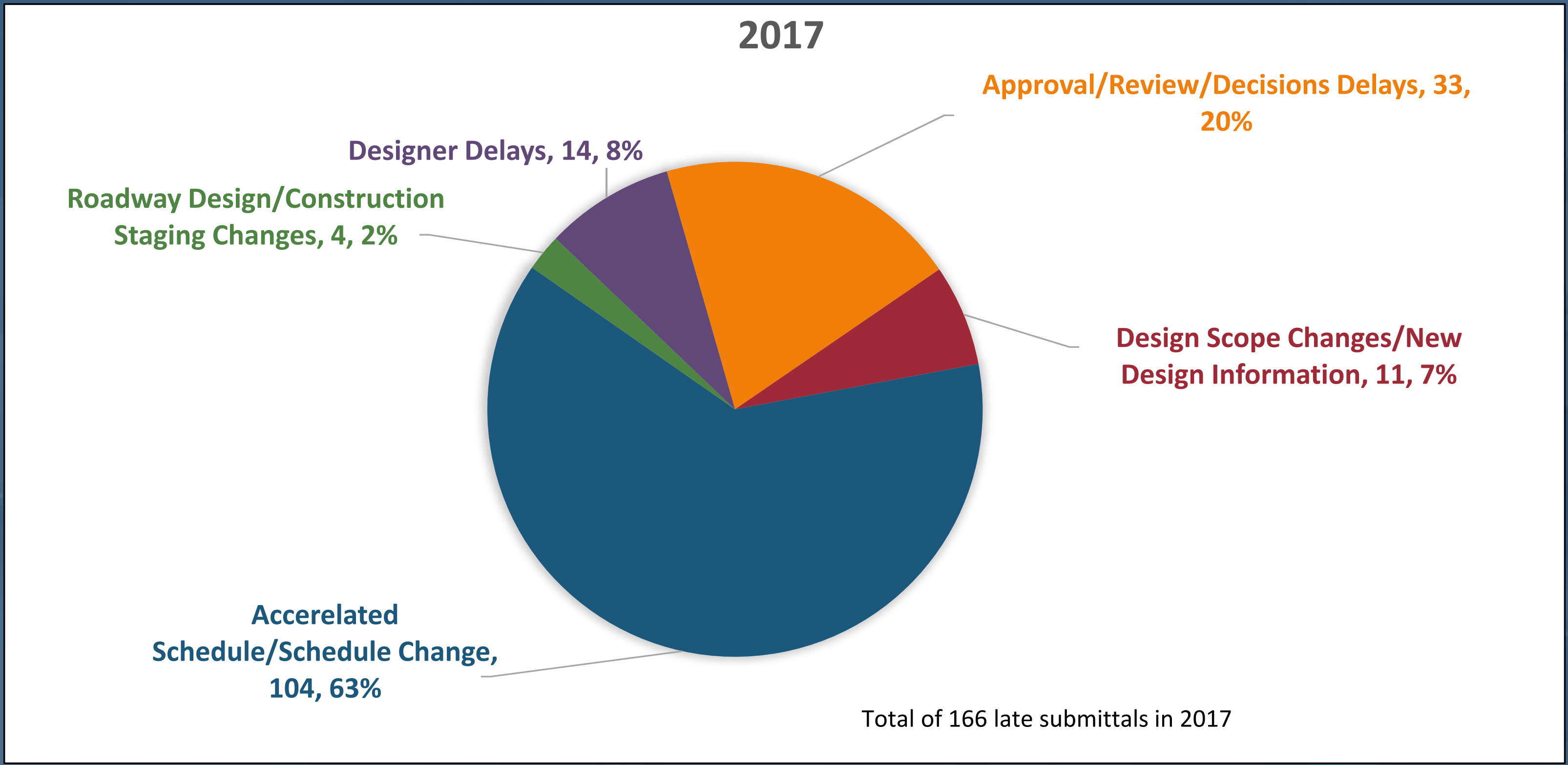
Why are past-deadline final plan submittals concerning to BOS

- We have a limited number of reviewers
- We have limited review time
- When plans are late, we have less time to work through issues with the designer
- We would like to provide input and QA reviews to as many submittals as possible
- Number of final structure plan submittals average about 120 per PS&E

On-Time Plan Submittal Improvement Form

- In March 2016, BOS implemented a new policy requiring designers to submit a form documenting the reasons for past-deadline final structure plan submittals.
- BOS categorized the reasons for past-deadline final structure plan submittals.

Reasons for Past-Deadline Final Structure Plan Submittals



Next Steps

- Designers- Please continue to communicate with BOS when project schedules are accelerated or advanced
- BOS- Will discuss with Regional offices impact of accelerated schedules on structure review timelines

Questions?

Automation, Policy & Standards

David Kiekbusch
Structures Development Supervisor

James Luebke
Structures Development Engineer

2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

May 22, 2018

BUREAU OF STRUCTURES

New standards in past two years

- 9.01 – Structure Backfill Limits and Notes
- 9.02 – Structure Backfill Limits and Notes 2
- 9.03 – Wing Fill Sections at Wing Tips
- 13.08 – Pier Cap Reinforcement Details
- 14.11 – MSE Wall – Panel and Block Facing
- 14.12 – MSE Wall – Wire Faced 1
- 14.13 – MSE Wall – Wire Faced 2
- 17.03 – Edge of Deck Flashing
- 27.10 – Steel Expansion Bearing Details
- 30.22 – Conduit Details and Notes
- 40.40 & 40.41 – Moved A4 abutments to Bridge Rehabilitation

Notable Bridge Manual text changes

- Extensive rewrite of Chapter 45 – Bridge Rating (January 2017)
  - Entire chapter rewritten
    - More logical order
    - Better guidance for when and how to load rate bridges
  - Four new rating examples for LFR
    - Reinforced Concrete Slab
    - Single Span Prestressed Girder
    - Two Span Prestressed Girder
    - Two Span Steel Girder

Bridge Manual text changes (continued)

AASHTO 3.8 – Wind Load: WL and WS

- Extensive update to Chapter 13 – Piers, including examples (July 2017)
  - Wind speeds for various limit states
  - Wind pressure is a function of the wind speed, exposure condition and bridge elevation above the ground or water surface
  - WisDOT policy items to simplify wind loading for most bridges

MASH 2016

MASH 2016

Required for all lets after December 31, 2019

- 42SS parapet required for:
  - All Interstate structures
  - All STH and USH with a posted speed ≥ 45 mph
- Railings Type ‘M’ and Types ‘NY 3’ and ‘NY 4’ are TL-2
  - Good for most local and collector roads with design speeds ≤ 45 mph
- Trying to get Type ‘M’ and Types ‘NY 3’ and ‘NY 4’ to TL-3
  - If TL-3 can’t be achieved, then a new railing (could be TL-4)

Bridge Maintenance and Bureau of Project Development Coordination

- Maintenance Items
- Erosion Issues
- Design Considerations

Bridge Maintenance Coordination

- Discuss Issues
  - Wing Wall Grading
  - Slope Paving Repairs
  - Approach Details
- Design Considerations

BPD Coordination

- Curb Usage
  - Recommended Increased Usage

BPD Coordination

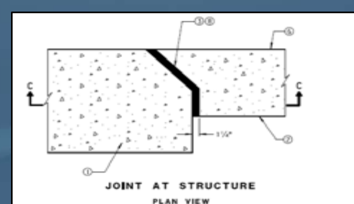
- Drainage Features
  - Curb Details
  - Flumes (efficiencies, location, etc.)
  - Alternative drainage features

BPD Coordination

- Approach Details
  - Construction Details
  - Site Specific Requirements

Parapets

- Fillet Detail
  - Drainage
  - Damage



Past Detail

Updated Detail

Parapets

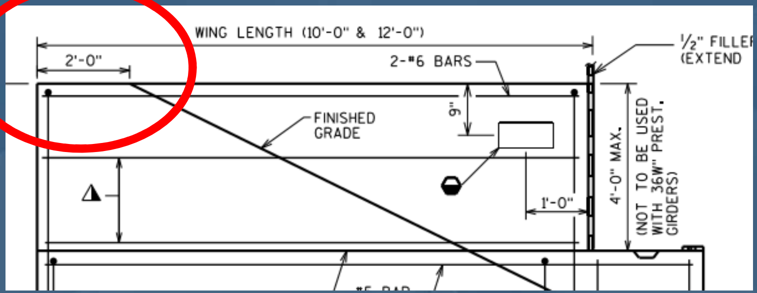
- Embankment Fills
  - Drainage
  - Damage

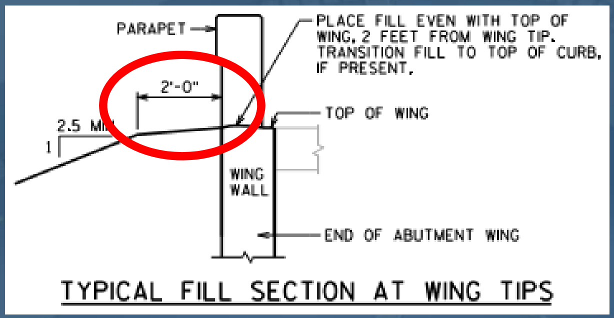
Wing Length

- Past Issues
  - Insufficient Embankment Fills
  - Beam Guard Embedment
  - Erosion Wing Tips

Wing Length

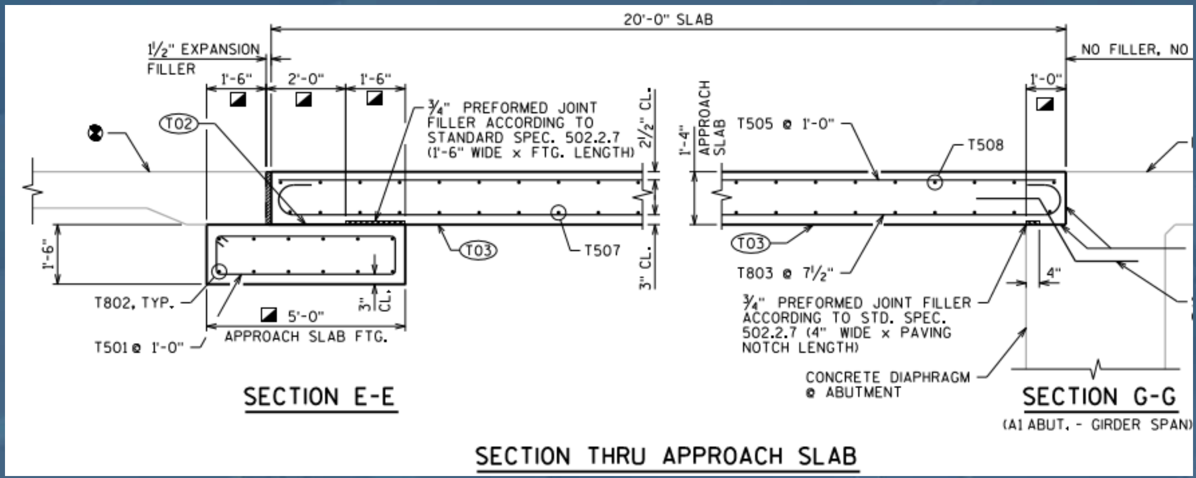
- Updates
  - 2:1 Slope + 2.0 ft (roundup)
  - 2 ft berm (section detail)





Structural Approach Slabs

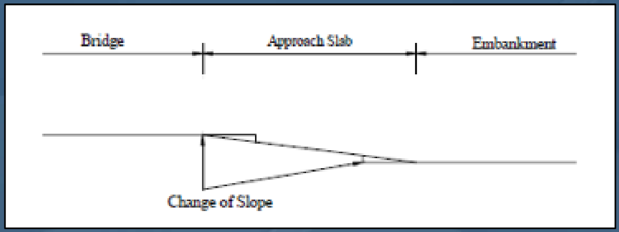
- Past Issues
  - Excessive Settlements
- Updates
  - Usage
  - Guidance



Structural Approach Slabs

- Current Usage
  - Required: IH and USH Bridges
  - Recommended: >3500 AADT
  - Not Required: Buried Structures & Culverts
  - Not Used: Rehabilitation Projects
  - *Design exceptions considered on a project-by-project basis.*

Structural Approach Slabs



- Guidance:
  - The geotechnical engineer should evaluate approaches for settlement susceptibility and provide recommendations for mitigating settlements prior to approach placement.
  - Structural approach slabs are not intended to mitigate excessive approach settlements.

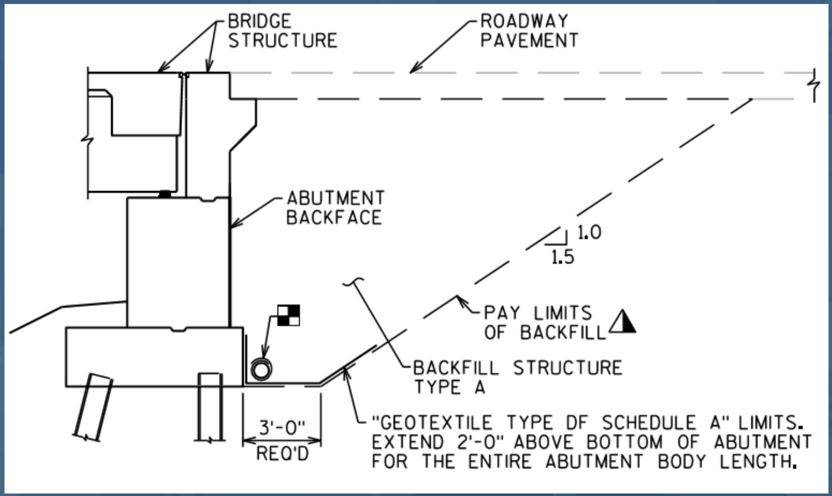
Structural Backfill

- Material Changes
- Payment of Quantities
- Past Maintenance Issues
  - Slope Stabilities
  - Erosion Issues

Structural Backfill

- Updates
  - Material
  - Geotextile
  - Pay Limits
  - Payment

Backfill placed beyond pay limits or exceeding plan quantities shall be incident



Structural Backfill

- Pay Limits
  - Not Necessarily Representative of Actual Limits
  - Payment Purposes Only

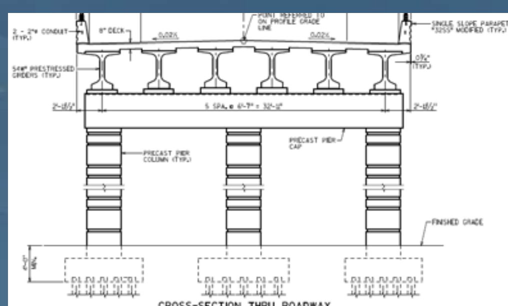
    Backfill placed beyond pay limits or exceeding plan quantities shall be incident
  - Excavation Limits – Contractor's Responsible

Precast Piers

- Past Usages
  - Research Projects – Required
  - Rawson Avenue - Required
  - IH 39/90 – Contractor's Option (noted allowance)
  - Sign Structure Column – Contractor Requested

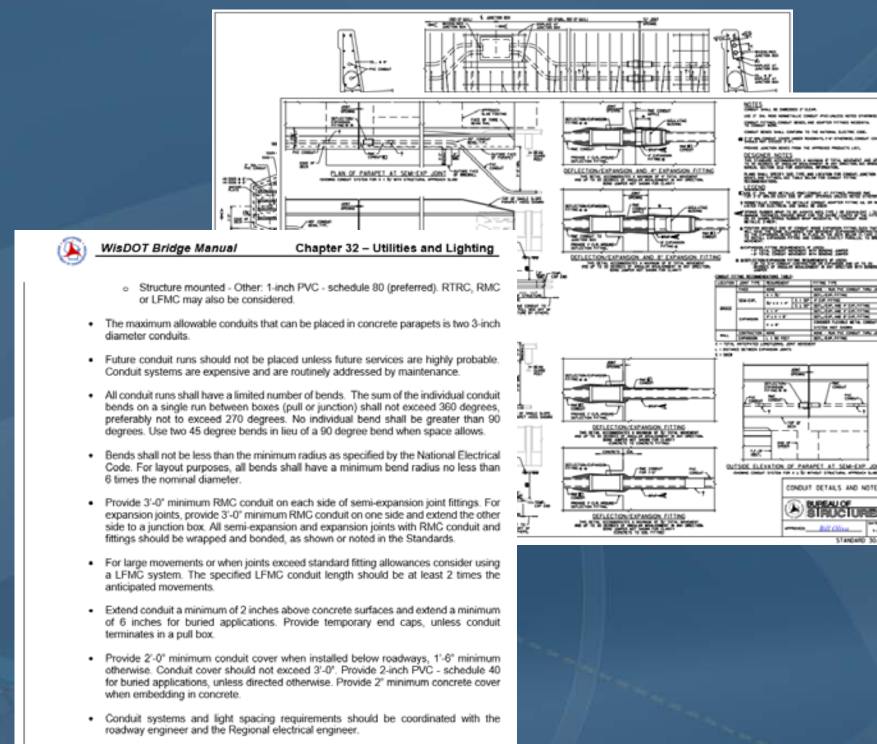
Precast Piers

- Current Policy
  - Pier configurations shall be determined by providing the most efficient cast-in-place concrete pier design, unless approved otherwise. When the cast-in-place design can accommodate a precast option, include the noted allowance.



Conduit

- Updates
  - Standards (30.21 & 30.22)
- WBM Updates
  - Design Guidance



WisDOT Bridge Manual **Chapter 32 – Utilities and Lighting**

  - Structure mounted - Other: 1-inch PVC - schedule 80 (preferred). RTRC, RMC or LFMC may also be considered.

- The maximum allowable conduits that can be placed in concrete parapets is two 3-inch diameter conduits.
- Future conduit runs should not be placed unless future services are highly probable. Conduit systems are expensive and are routinely addressed by maintenance.
- All conduit runs shall have a limited number of bends. The sum of the individual conduit bends on a single run between boxes (pull or junction) shall not exceed 360 degrees, preferably not to exceed 270 degrees. No individual bend shall be greater than 90 degrees. Use two 45 degree bends in lieu of a 90 degree bend when space allows.
- Bends shall not be less than the minimum radius as specified by the National Electrical Code. For layout purposes, all bends shall have a minimum bend radius no less than 6 times the nominal diameter.
- Provide 3'-0" minimum RMC conduit on each side of semi-expansion joint fittings. For expansion joints, provide 3'-0" minimum RMC conduit on one side and extend the other side to a junction box. All semi-expansion and expansion joints with RMC conduit and fittings should be wrapped and bonded, as shown or noted in the Standards.
- For large movements or when joints exceed standard fitting allowances consider using a LFMC system. The specified LFMC conduit length should be at least 2 times the anticipated movements.
- Extend conduit a minimum of 2 inches above concrete surfaces and extend a minimum of 6 inches for buried applications. Provide temporary end caps, unless conduit terminates in a pull box.
- Provide 2'-0" minimum conduit cover when installed below roadways, 1'-6" minimum otherwise. Conduit cover should not exceed 3'-0". Provide 2-inch PVC - schedule 40 for buried applications, unless directed otherwise. Provide 2" minimum concrete cover when embedding in concrete.
- Conduit systems and light spacing requirements should be coordinated with the roadway engineer and the Regional electrical engineer.

Local Program bridges

- Railings and parapets to be MASH compliant:
  - Chapter 30 of Bridge Manual gives a MASH TL value for all railings and parapets
- Local road design speed versus posted speed (or no posted/statutory speed)
  - Will be working with Bureau of Project Development to provide guidance

Bridge drainage

- Desirable to maintain 0.50% profile for drainage, with solid parapets (WisDOT preference)
  - Investigating exceptions to the 0.50% criteria, especially for shorter bridges.

Future updates

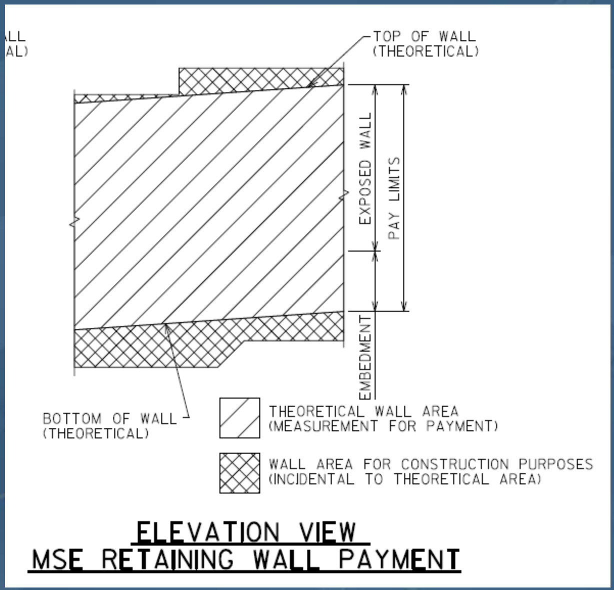
- July Bridge Manual updates
  - Text with regards to AASHTO 8th Edition (Examples in January 2019)
    - Renumbering of Section 5 Concrete Structures (461 references in BM!)
    - New method for prestressed girder shear
    - New steel girder simplified field splice design procedure
  - ½” filler adjacent to ½” bearing pads
- Other
  - Insert sheets are being cleaned up – available as ready
  - Insert sheet(s) with available cells

Automation

- WiSAMS – Wisconsin Structures Asset Management System
  - Automated system to assist with determining the most appropriate course of action for structure maintenance, and eventual replacement, during its life cycle
  - Planners like it, bridge maintenance staff is a little more skeptical…
- Data Warehouse/Business Intelligence
  - Centralized location for all data related to WisDOT structures
  - Used to support important business activities
- BIM for Bridges and Structures

MSE Wall Specifications

- Updates
  - Pay Limits (Plan Values)
  - Shop Drawing Submittal



Shear Design – PS Girders

- Simplified Procedure removed from AASHTO LRFD 8th Edition for Prestressed Sections

V_c = the lesser of V_{ci} and V_{cw};

$$V_{ci} = 0.02\sqrt{f'_c}b_v d_v + V_d + \frac{V_i M_{cre}}{M_{\max}} \geq 0.06\sqrt{f'_c}b_v d_v$$

$$V_{cw} = \left(0.06\sqrt{f'_c} + 0.30 f_{pc}\right) b_v d_v + V_p$$

Shear Design – PS Girders

- Update: Use General Procedure

$$V_c = 0.0316\beta\sqrt{f'_c}\, b_v d_v$$

$$\beta = \frac{4.8}{(1+750\varepsilon_s)}$$

$$\varepsilon_s = \frac{\left(\frac{|M_u|}{d_v} + 0.5N_u + |V_u - V_p| - A_{ps}f_{po}\right)}{E_sA_s + E_pA_{ps}}$$

Shear Design – PS Girders

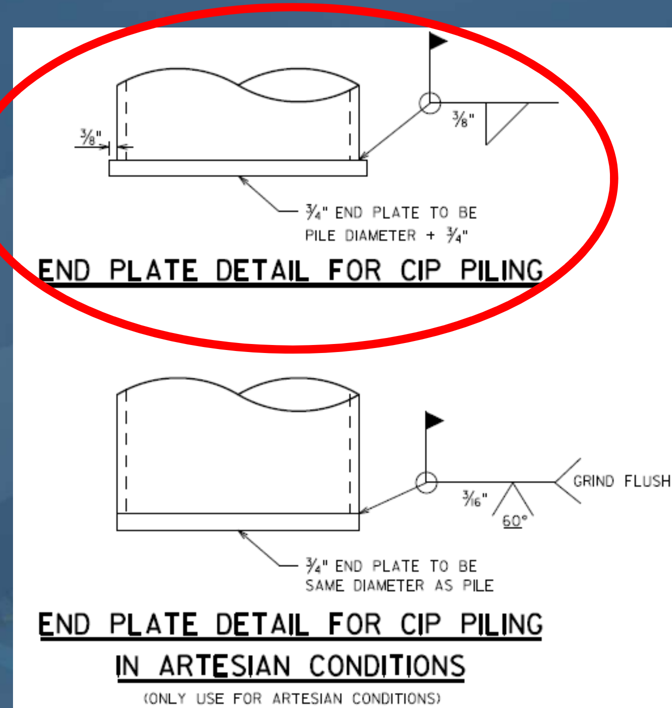
- Update: Use <u>General Procedure</u>
- Software Updates: In-House (in progress)

<u>WisDOT policy item:</u>

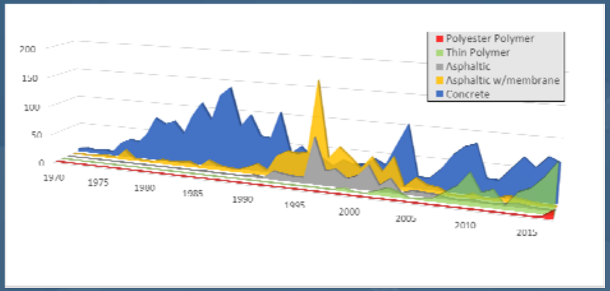
Web shear reinforcement shall be designed by **LRFD [5.7.3.4.2]** (General Procedure) using the Strength I limit state for WisDOT standard girders.

CIP Piles

- Additional Detail (Std. 11.01)
  - End Plate Detail For CIP Piling
- Specifications
  - Welds watertight (2019 spec)
  - Agg. size (2020 spec?)



Overlay Guidance



- Past Usages
- Overlay Systems
- Summary of Updates
- Polymer Overlays

Overlay Type	Advantages	Disadvantages	Notes
Thin Polymer Overlay	• Minimal dead load • Minimal traffic disruptions • Seals the deck • Provides traction	• Requires a concrete age of at least 21 days • Requires decks with minimal defects and low chloride concentrations • Sensitive to moisture, temperature, and humidity at placement • Reflective cracking concerns	
Low Slump Concrete Overlay	• Contractor familiarity and department experience • Long life span potential • Durable • Ease to accommodate grade differences and deficiencies	• Traffic disruptions • Additional dead load • High maintenance requirements • Railing height concerns • Susceptible to cracking • Specialized finishing equipment	• May require crack sealing the following year and periodically thereafter
Polyester Polymer Concrete Overlay	• Minimal dead load • Minimal traffic disruptions • Seals the deck • Provides traction • Long life span potential • Durable • Low maintenance requirements	• High cost • Dedicated equipment • Limited usage in Wisconsin • Sensitive to moisture, temperature, and humidity at placement • Reflective cracking concerns	• Requires BOS Prior-Approval
Polymer Modified Asphaltic Overlay	• Minimal traffic disruptions • Ease to construct • Can be used on more flexible structures (e.g. timber decks or timber slabs)	• High cost • Susceptible to permeability • Difficult to assess top of deck condition	• Contact region for availability • Minimal research has been performed on the durability of this system in Wisconsin
Asphaltic Overlay	• Low cost • Ease to construct • Ease to accommodate grade differences and deficiencies	• Short life span • Not eligible for federal funds • Overlay permeability • Difficult to assess top of deck condition	• Deck or bridge replacement should be programmed within 4 years
Asphaltic Overlay with Membrane	• Ease to construct • Minimal traffic disruptions • Long life span potential • Can be used on more flexible structures (e.g. PS box girders)	• Susceptible to permeability • Requires a membrane • Difficult to assess top of deck condition	• Currently under review • Requires BOS Prior-Approval

Table 40.5-2
Overlay Advantages, Disadvantages, and Notes

Questions?

Answers??

My Favorite Complex Structures

Andrew Smith
Load Rating Engineer

2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

May 22, 2018

BUREAU OF STRUCTURES

The “Home Sweet Home” Bridge

Category: Movable Bridge

- First Movable Bridge constructed with ABC techniques.
- Bridge operator lives on site

BUREAU OF STRUCTURES

Bridge over Achievement Gap

Category: Box Girder Bridge

- Built by Red Neck and Sons
- Cost: 4 bottles of whiskey
- No children were hurt during construction

Load Rating
~~My Favorite~~ Complex Structures

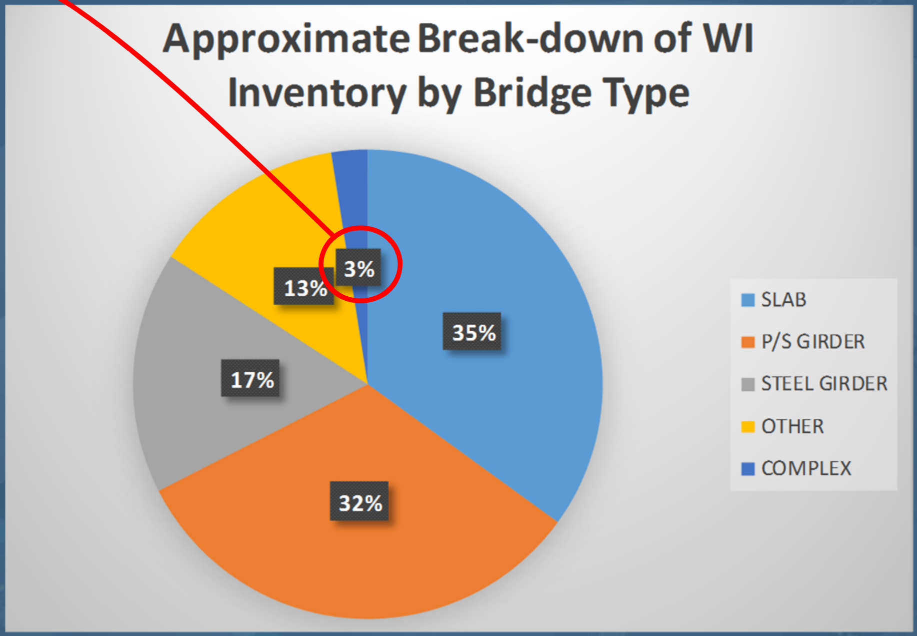
Andrew Smith
Load Rating Engineer

2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

May 22, 2018

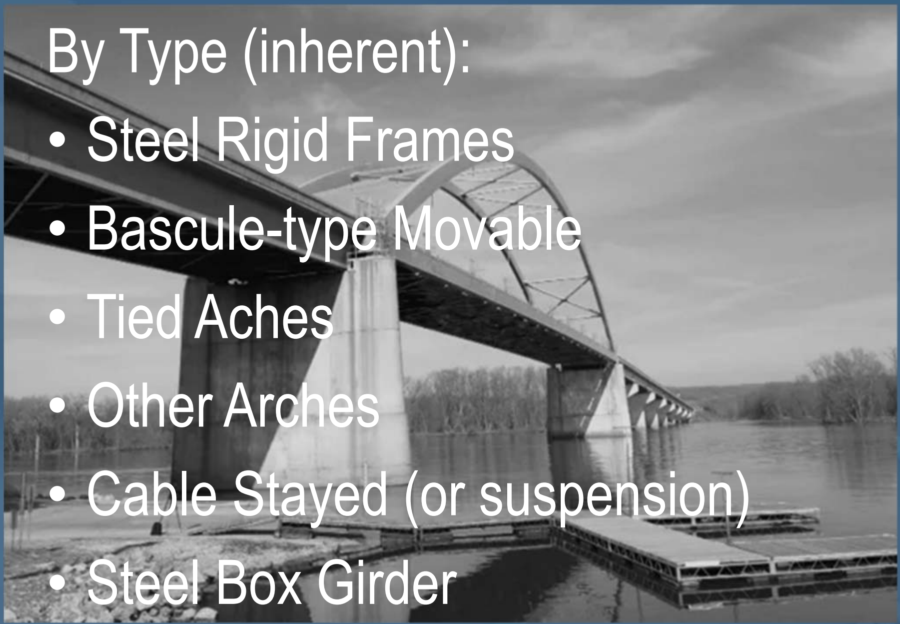
BUREAU OF STRUCTURES

A Band of Complex Misfits



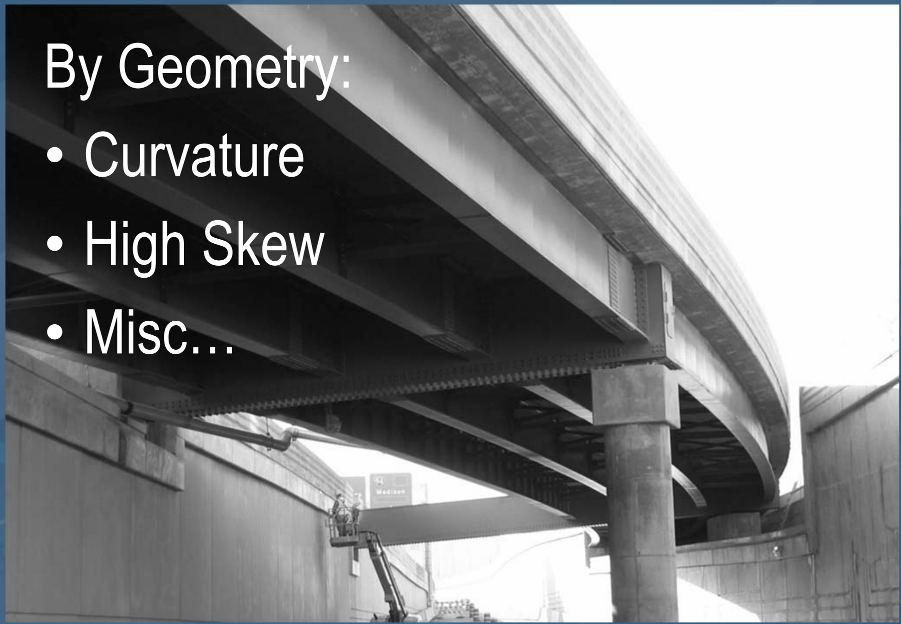
What is Considered Complex?

WisDOT Bridge Manual 45.3.11



By Type (inherent):

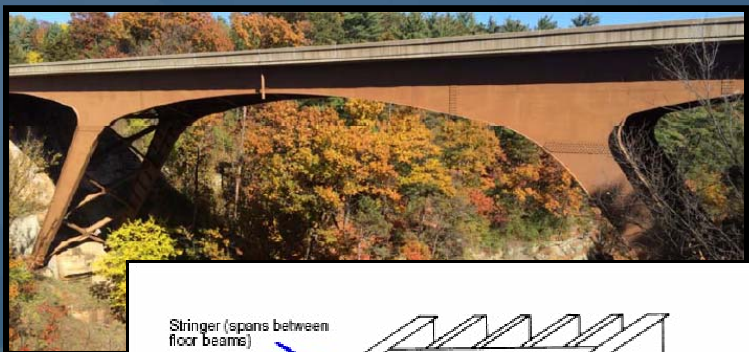
- Steel Rigid Frames
- Bascule-type Movable
- Tied Aches
- Other Arches
- Cable Stayed (or suspension)
- Steel Box Girder

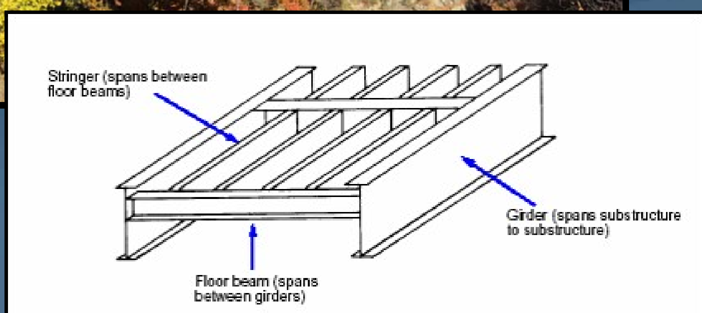


By Geometry:

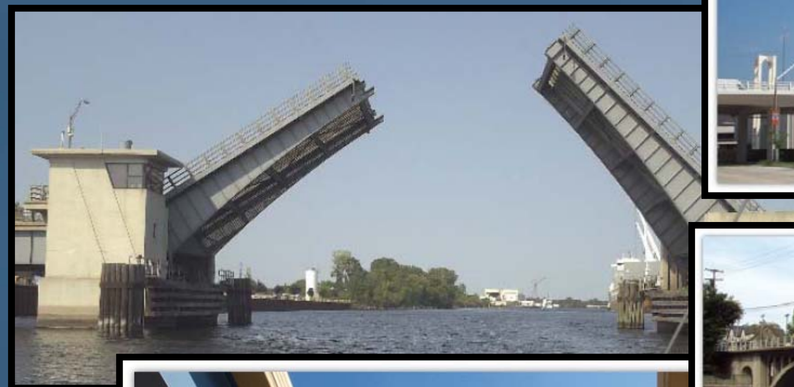
- Curvature
- High Skew
- Misc…

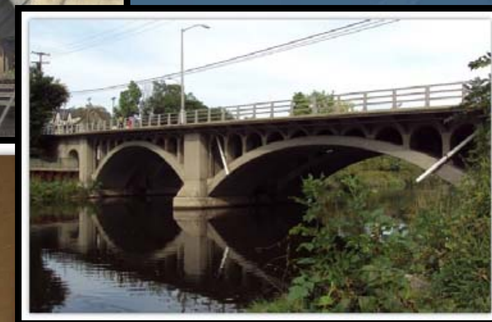
By Type





Stringer (spans between floor beams)
Girder (spans substructure to substructure)
Floor beam (spans between girders)

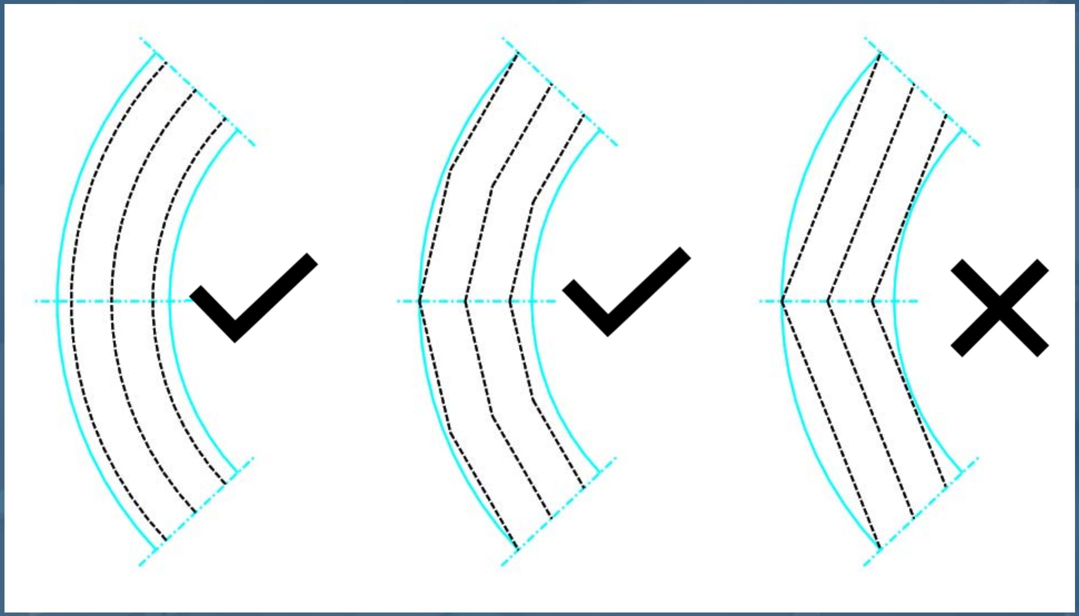




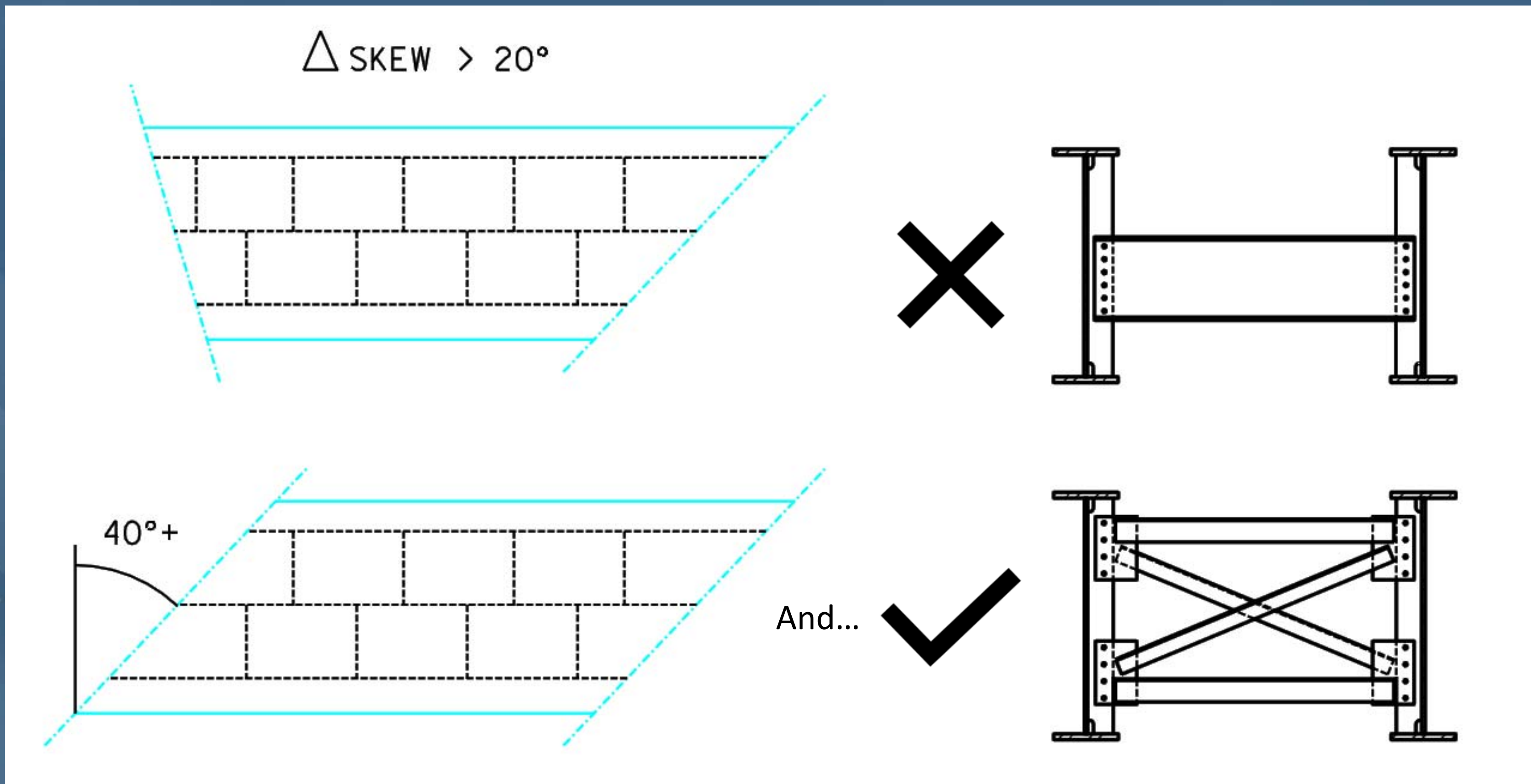
By Geometry: *Curvature*

See LRFD 4.6.1.2.4 and Curved Steel Girder Guide Spec 4.2

- Girders are concentric;
- Bearing lines are not skewed more than 10 degrees from radial;
- The stiffnesses of the girders are similar;
- For all spans, the arc span divided by the girder radius in feet is less than 0.06 radians where the arc span, L_{as}, shall be taken as follows:



By Geometry: *High Skew (2nd Tier)*



Please contact Rating Unit if…

"Flexible" Supports

Girder Flare

Complex Framing

What is required if a structure is categorized "complex"?

Generally… That these complexities are considered in a Load Rating Analysis

Specifically (45.3.11)…

1. Refined analysis is required
   - Design of new "complex" structures will be "refined" by default
2. Must consider certain load effects (e.g. from curvature and skew)
   - Already in national guidance
3. Submit Refined Analysis Rating Form (on website)
   - Flexible format – provide key information

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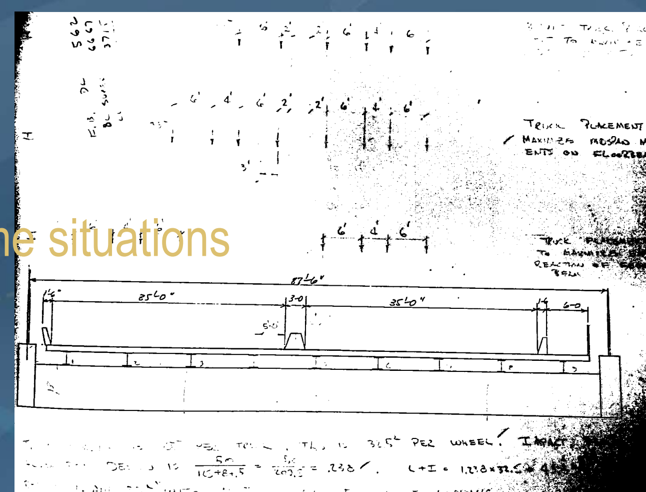
What constitutes “refined” analysis?

- National resources: AASHTO, FHWA “Manual of Refined Analysis” (in-progress), NSBA G13.1
- Generally considered to be FEA (2D vertical/horizontal, PEB, 3D)
  - Chp 45 not dictating how to perform refined analysis
  - May depend on project requirements
- Refined ≠ Complex
  - A 3D FE model can arguably be more efficient in some situations

e.g. stringer → floorbeam → girder



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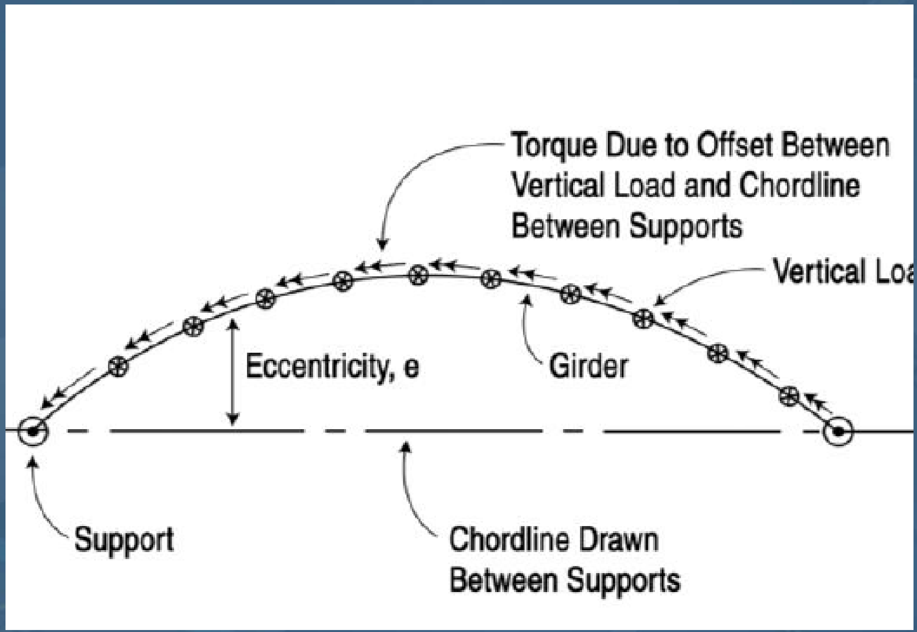
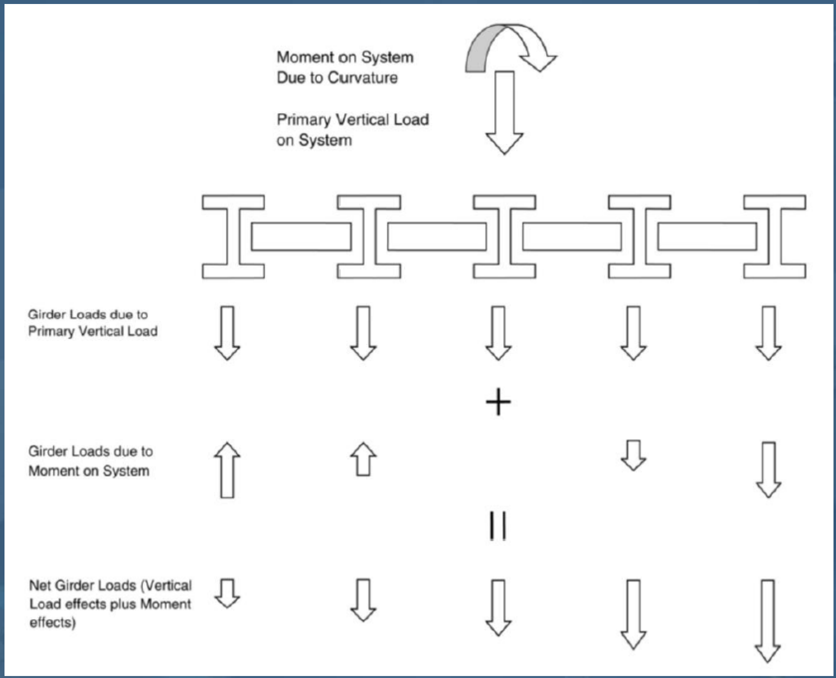
Torsion

- Caused by eccentric loading (i.e. structure on a horizontal curve)
- Torque is imparted to girders
- Results in additional normal and shear stresses (on top of those imparted from primary bending)
- Box girders and plate girders handle this differently



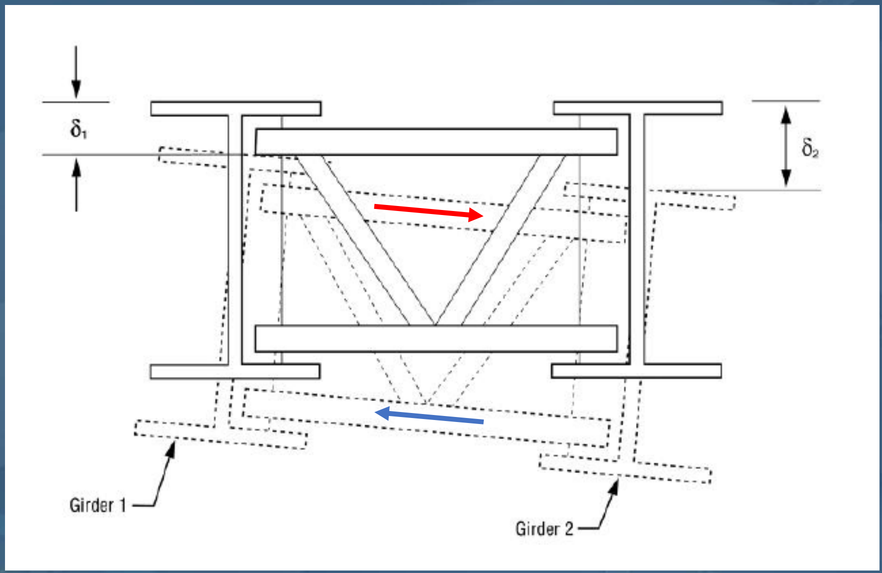
Load Shifting

- Global overturning resisted by force couples
- Additive effect to some girders, relieving effect to others
- Analogous to overturning (moment, eccentric load) in pile groups
- If curve is slight enough, the effects of curvature on the gravity loads (i.e. “load shifting”) can be neglected – see LRFD 4.6.1.2.4



Flange Lateral Bending

- Flange Lateral Bending due to curvature effects must always be accounted for per LRFD
- Effects of Skew on f_ℓ are more variable and difficult to predict
  - Investigate effects with discontinuous cross-frames with skews greater than 20°
- f_ℓ due to skew determined by:
  1. Directly (3D FEM)
  2. Approximate eqns. and recommended values – see C6.10.1



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Refined Analysis Rating Form

In Addition to this form, submit electronic analysis files (eg. .MDX, .bdb)

Analysis File Summary (fill out for each analysis file submitted)

Analysis Type:	☐ Grid/Grillage ☐ Plate & Ecc. Beam ☐ 3D FEM ☐ Other *(describe below)*
Analysis Program:	☐ MDX ☐ AASHTOWare ☐ CSI Bridge ☐ LARSA ☐ Other
Program Version:	
File Name:	
File Description:	Describe the purpose of the file. Example: This file is used for the Wis-SPV rating using single lane distribution.
Analysis Assumptions:	Highlight key assumptions in modeling. (This section may be omitted if submitting MDX or AASHTOWare analysis files. This section may also be omitted if submitting separate document containing analysis assumptions and results). Example of things to include: a description of the finite element model, simplifications made to model, exceptions to original design plans, loads applied, how loads are applied (e.g. equally distributed to all girders), support conditions, composite/non-composite sections.
Summary of Results:	Summarize results. (This section may be omitted if submitting MDX or AASHTOWare analysis files. This section may also be omitted if submitting separate document containing analysis assumptions and results). Provide table of results for service load reactions, moment, shear, and/or stress output for members at 10th points (minimum) for the appropriate load cases. Provide a table of capacities at each 10th point, such that load ratings can be directly computed with appropriate load and/or resistance and impact factors. Provide example or typical calculations.

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OR...

Your own template is fine…

DOUGLAS COUNTY, WI

ST. LOUIS COUNTY, MN

CITY OF SUPERIOR, WI
&
CITY OF DULUTH, MN

USH 2 OVER ST. LOUIS RIVER (BONG BRIDGE)

STRUCTURE B-13-38

RATING COMPUTATIONS

48-SPAN STEEL PLATE GIRDER BRIDGE

1.5" MIN. OVERLAY

HS-20 LOADING

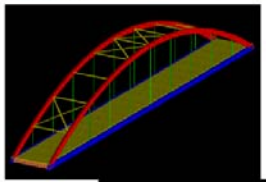
April 2013

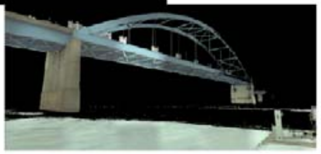
AYRES ASSOCIATES

Ayres Associates Project Number: 42-0825.00

Designed by: Date: 4-23-13
Checked by: Date: 6-28-13

Bridge Evaluation
WisDOT Project ID: 0656-22-11
Bridge: B-12-27
Hwy. 18/60 EW over Mississippi River
Prairie du Chien, WI
Submitted by: Teng & Associates, Inc
March 2012





ADS 3/19/2014

Rating of Concrete Arch (B-37-568)

Eau Claire Dell's Bridge
Town of Plover
Marathon County

Summary of Rating

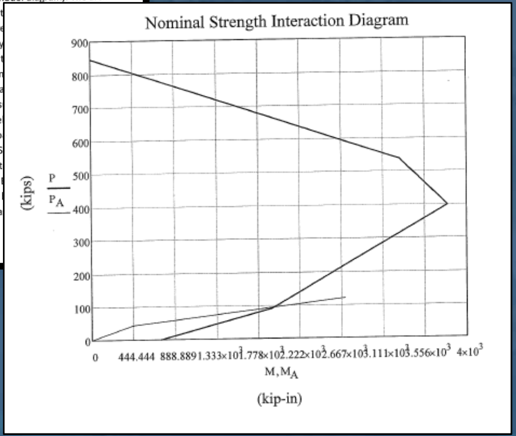
Controlling Location: Element 2 & 15
Rating Method: LFR
Rating: HS-28 (inventory)
HS-47 (operating)
Posting: No
Comment: Evaluation requested due to deterioration of and stone facing. The main structural compo good condition and no section loss was assum model analysis, the controlling elements are There is a degree of conservativeness to the dictate live load distribution and impact vary controlling factor was applied to the entire b

Analysis

Program/Method: CSI Bridge, P-M interaction diagrams
Assumptions: The arch was modeled as a 2-dimensional frame (see model diagram). The arch barrel was subdivided into smaller sections to capture t section properties. The remaining frame elements were moment-released end conditions, so as to transfer only arch barrel. Nodes were connected at angles to mimic t through soil. Supports were located at the construction original structure plans and assumed fixed to rotation a spring was assigned to resist lateral translation of the s based on a 12" tributary width. Weight due to spandre equally distributed to the 30-ft total arch width. Live lo calculated according to section 3.24 and 6.4 of the AAS Specification. Horizontal earth pressure was assumed t the arch. Per 6A.5.7 of the AASHTO Manual for Bridge members subjected to axial and flexural forces should interaction diagrams. Once the interaction diagram wa the analysis were used to obtain a rating.

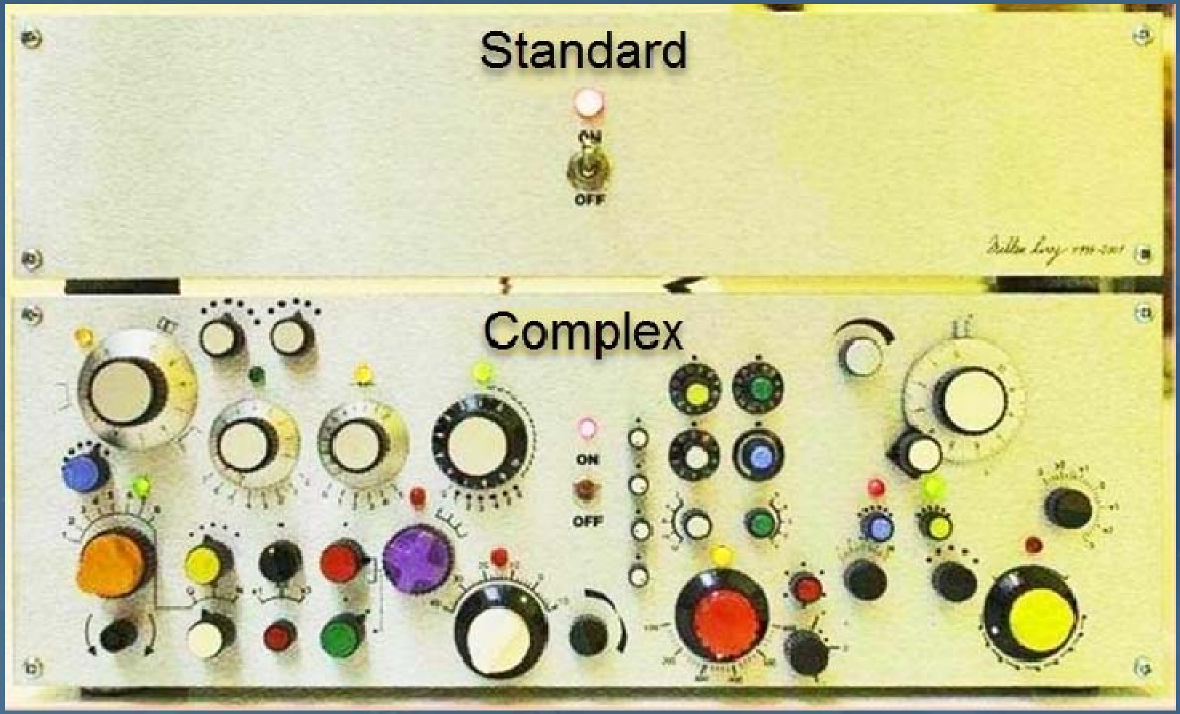
Element	Controlling Thickness [in]	Controlling Reaction P_{DL} [kips]	M_{DL} [kip-ft]	P_{LL} [kips]	M_{LL} [kip-ft]	RATING (HS-xx) inventory	operating
1	41.5	45.9	42.5	12.1	36.5	46	76
2	31.25	42.6	36.3	12.9	31.5	28	47
3	26.5	40.7	22.1	13.2	23.3	39	66
4	22.75	39.8	14.9	13.3	16.9	54	90
5	20.5	38.4	9.2	13.4	13.5	61	103
6	17.0	37.5	3.6	13.3	11.4	63	105
7	14.75	36.7	3.8	13.1	11.6	43	73
8	14.0	36.3	1.9	12.8	10.4	45	75

Rating Results Table



…But please fill it with meaningful information

Why is this "complex" distinction important?



What are the benefits?

- Consistency
  - In analysis assumptions
  - Among engineers
- Repeatability/Documentation
  (Refined Analysis Rating Form)
  - For timely responses in permitting requests
  - Scoping, Posting, Damage

Performing a load rating on a complex structure?

Please contact rating unit:

Andrew Smith
Andrew.Smith@dot.wi.gov
608-266-0989

Josh Dietsche
Joshua.Dietsche@dot.wi.gov
608-266-8353

Self-Consolidating Concrete for Prestressed Girders

Steven Doocy, P.E.

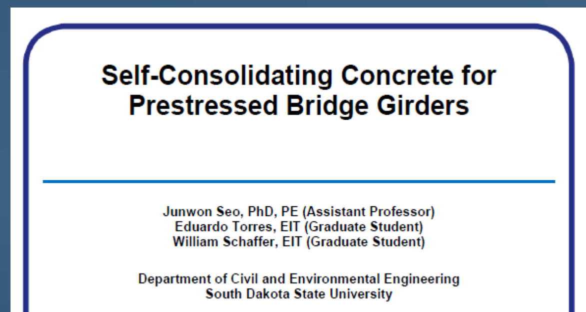
2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

May 22, 2018

BUREAU OF STRUCTURES

Introduction

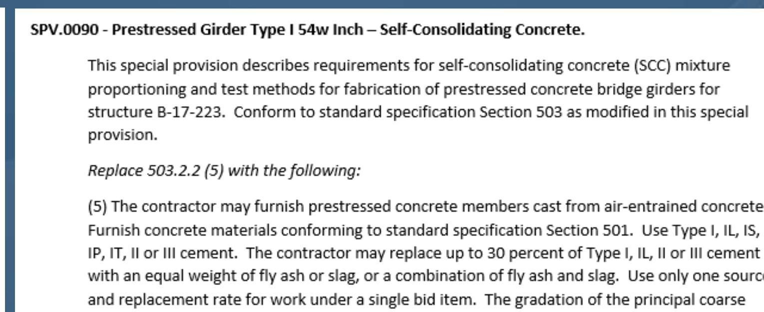
- Research
- Test Girder
- Specification
- Implementation



Self-Consolidating Concrete for Prestressed Bridge Girders

Junwon Seo, PhD, PE (Assistant Professor)
Eduardo Torres, EIT (Graduate Student)
William Schaffer, EIT (Graduate Student)

Department of Civil and Environmental Engineering
South Dakota State University



SPV.0090 - Prestressed Girder Type I 54w Inch – Self-Consolidating Concrete.

This special provision describes requirements for self-consolidating concrete (SCC) mixture proportioning and test methods for fabrication of prestressed concrete bridge girders for structure B-17-223. Conform to standard specification Section 503 as modified in this special provision.

Replace 503.2.2 (5) with the following:

(5) The contractor may furnish prestressed concrete members cast from air-entrained concrete. Furnish concrete materials conforming to standard specification Section 501. Use Type I, IL, IS, IP, IT, II or III cement. The contractor may replace up to 30 percent of Type I, IL, II or III cement with an equal weight of fly ash or slag, or a combination of fly ash and slag. Use only one source and replacement rate for work under a single bid item. The gradation of the principal coarse

Research Team

- Researchers
  - South Dakota State University
- Industry
  - County Materials
  - Spancrete
- WHRP Team
  - WisDOT
  - UW-Madison

Research

- Goals
  - Develop mixture and testing requirements to supplement the Std. Spec.

(6) The contractor shall determine the proportions for the mix within the following limitations:

Water/cementitious material ratio (w/cm)	0.35 or less (1)
Cementitious materials content	750-800 pounds per cubic yard
Fine aggregate to total aggregate ratio	0.50 or less
Air content for prestressed I-type girders	6.0 percent maximum
Slump Flow (per ASTM C1611)	25 to 28 inches (2)
Visual Stability Index (VSI) (per ASTM C1611)	0 to 1
Passing Ability by J-Ring (per ASTM C1621)	+/- 2.0 inches difference from slump flow
Column Segregation (per ASTM C1610)	15 percent maximum

Research

- Results
  - Strength
  - Camber
  - Transfer length
  - Losses due to creep and shrinkage

Table 1 Compressive Strength Results

Time	CC (psi)	SCC (psi)
16 hr.	8157	7477
28 Days	11505	11270

Table 2 Camber Results

Time	CC (in)	SCC (in)
Day 1	0.62	0.5
28 days	1.0	1.25

Table 3 Transfer Length Results

Time	CC (in)	SCC (in)	AASHTO (in)
1 Day (Immediately after release)	24.0	19.0	36
28 Days	24.5	20.0	

Table 4 Prestress Losses

Time	CC (ksi)	SCC (ksi)	Type of Losses
1 Day (after release)	10.61	9.077	Elastic Shortening
1st week	11.85	10.59	Time-Dependent Properties
2nd week	12.83	11.70	
3rd week	13.05	11.94	
4th week (28 days)	14.07	12.92	

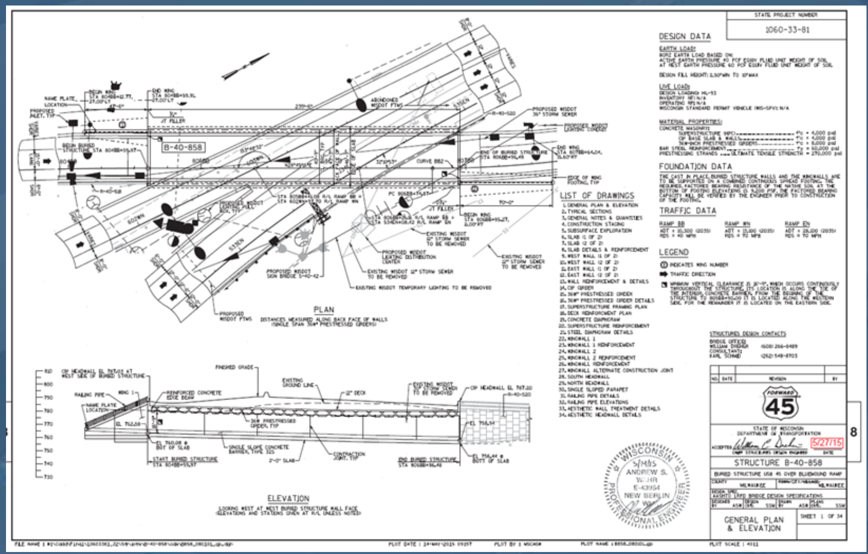
Test Girder

B-40-858

Test Girder

B-40-858

- 28 – 36W girders, 41’-9” long
- County Materials donated a girder (cast 29 total girders, 28 normal concrete, 1 SCC) for proof of concept
- If SCC girder met specifications, we would install it on the bridge



Test Girder

Conventional Pour

Test Girder

SCC Pour

Specification

- SPV for SCC
  - Concise SPV was developed with WisDOT Materials section
  - Specified testing, material and construction information for SCC.

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Visual Stability Index (VSI) (per ASTM C1611).. 0 to 1

Passing Ability by J-Ring (per ASTM C1621) .... +/- 2.0 inches difference from slump flow

Column Segregation (per ASTM C1610)... 15 percent maximum

For qualification of new mixes, demonstrate passing test results for all required properties. During concrete production using accepted mixes, test air content, slump flow and VSI for every load, and test J-ring and column segregation a minimum of once daily.

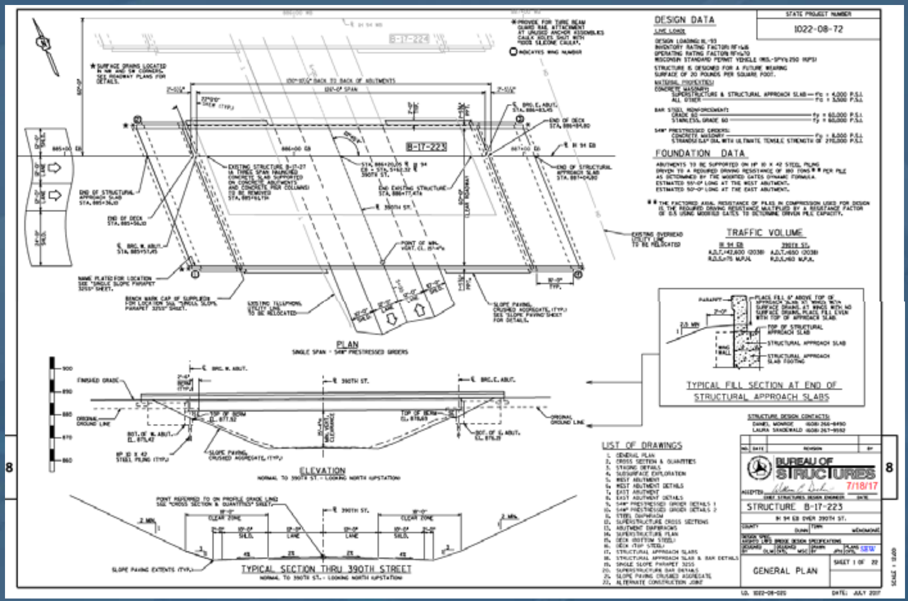
[1]The water/cementitious materials ratio is the weight of the total added water plus the aggregate free water, divided by the total weight of the cement, fly ash and slag.

[2]Proportion the mix to provide a uniform quality and consistency with a slump flow no greater than necessary for proper placement and consolidation.

Implementation

B-17-223/224

- Looked for longer structure with deeper girders
- 10 – 54W girders @ 127’ long (twin structures)
- 223 – mandatory SCC
- 224 – optional SCC



Implementation

- Cost??

Implementation

Current Data

Camber

- Actual = 4.00”
- Plan = 4.28”

Compressive Strength

- f'_{ci} (actual) = 7,900 psi f'_{c} (actual) = 12,500 psi
- f'_{ci} (plan) = 6,800 psi f'_{c} (plan) = 8,000 psi

Success!!

- Started with a little research
- Lead to a SPV
- Implemented on twin structures
- Future cases……
  - Use for all girders
  - Complex concrete pours/tight rebar cages
  - Substructures
  - Other?

Questions

Miscellaneous Geotechnical/Structural Topics

Jeff Horsfall
BTS – Geotechnical Engineer

2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

May 22, 2018

BUREAU OF STRUCTURES

Communications

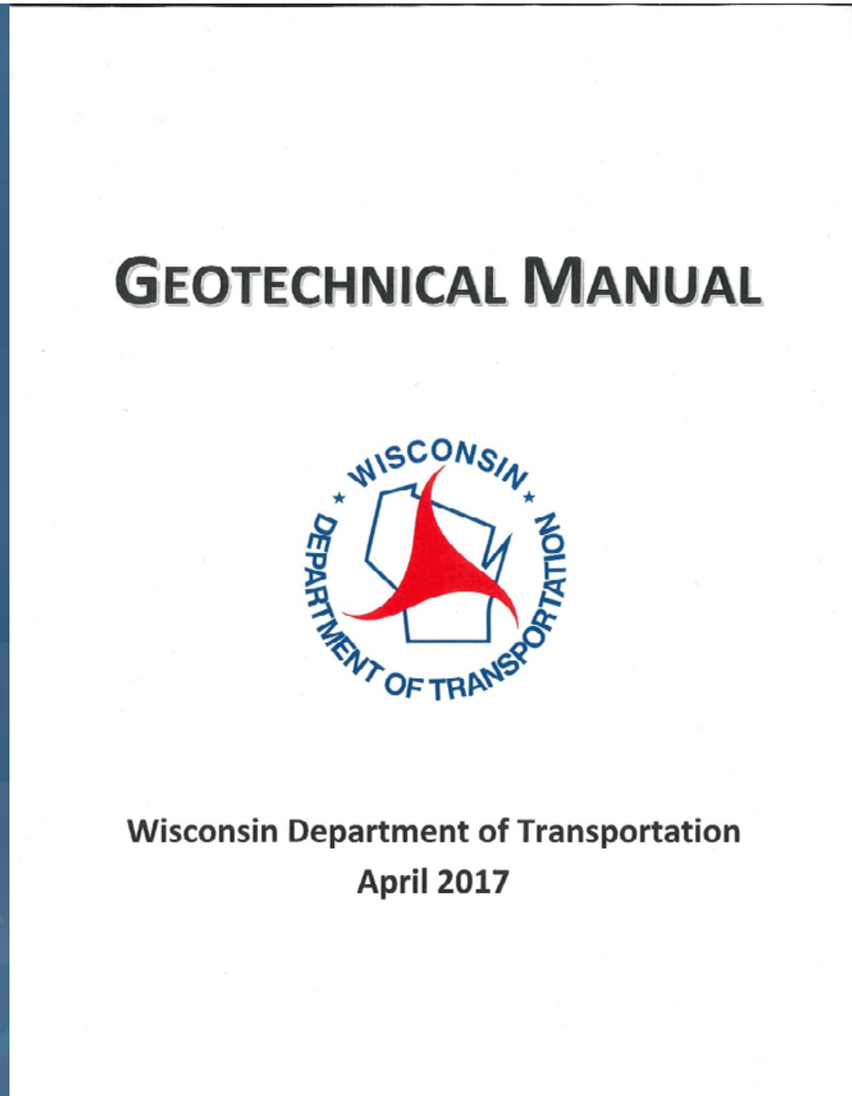
Geotechnical/Structural Topics

- Geotechnical Manual
- Consultant Submittals
- Pre-boring in Consolidated Material (Intermediate GeoMaterial-IGM)

Geotechnical Manual

- Developed in April 2017 and published on the DOTNET

http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/default.aspx



GEOTECHNICAL MANUAL

Wisconsin Department of Transportation
April 2017

Section 7-1 General

Section 7-2 Foundation Types

Section 7-3 Foundation Analyses and Design

Section 7-4 Subsurface Investigations – All Structures

Section 7-5 Bridges

Section 7-6 Retaining Walls

Section 7-7 Box Culvert, Rigid Frame and Plate Arches

Section 7-8 Ancillary Structures

Consultant Submittals

Special Provisions template gives:

I. SOILS AND SUBSURFACE INVESTIGATIONS

Add gINT soil boring logs and soils laboratory data to the following email addresses.

DOTDTSDGeotechnicalgINT@dot.wi.gov
DOTDTSDGeotechnicalSirLab@dot.wi.gov

Pre-boring in Consolidated Material (Intermediate GeoMaterial-IGM)

550.3.9 Pre-Boring

550.3.9.1 General

(1) Pre-bore holes to the depth the plans or special provisions require. Submit written requests for pre- boring not required under the contract to the engineer for review and approval. Do not impair the capacity of in-place piles or damage adjacent structures by pre-boring operations.

550.3.9.3 Pre-Boring in Rock or Consolidated Materials

(1) For round piles, pre-bore holes at least one inch larger than the pile outside diameter. For other shapes, pre-bore holes at least one inch larger than the greatest diagonal pile section dimension.

(2) Case holes as necessary to prevent introduction of unconsolidated material. Seat the casing firmly into the rock or consolidated material surface. Clear debris from the pre-bore hole before installing the pile.

(3) Firmly seat piles after preboring and backfill within the rock or consolidated material with a cement grout. Remove the casing, backfill the piles with sand or other engineer-approved material, and dispose of excess material.

(4) Do not blast without the engineer's approval.

Pre-boring in Consolidated Material (Intermediate GeoMaterial-IGM)

Intermediate GeoMaterial-IGM

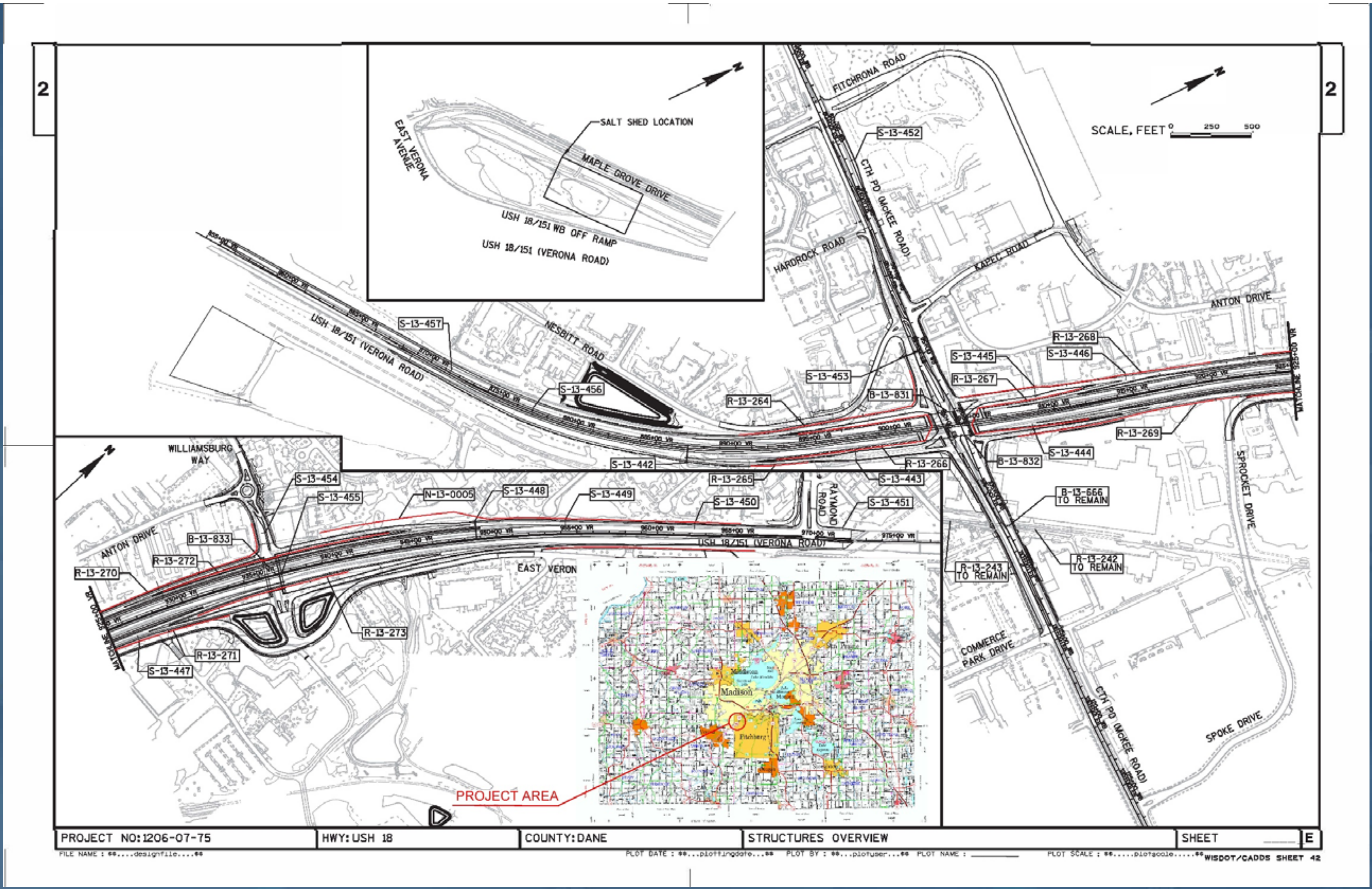
- Cohesive IGMs exhibited unconfined compression strengths between 10 ksf to 100 ksf
- Cohesionless IGMs exhibited blow counts greater than 50 blows per foot (bpf) using a Standard Penetration Test

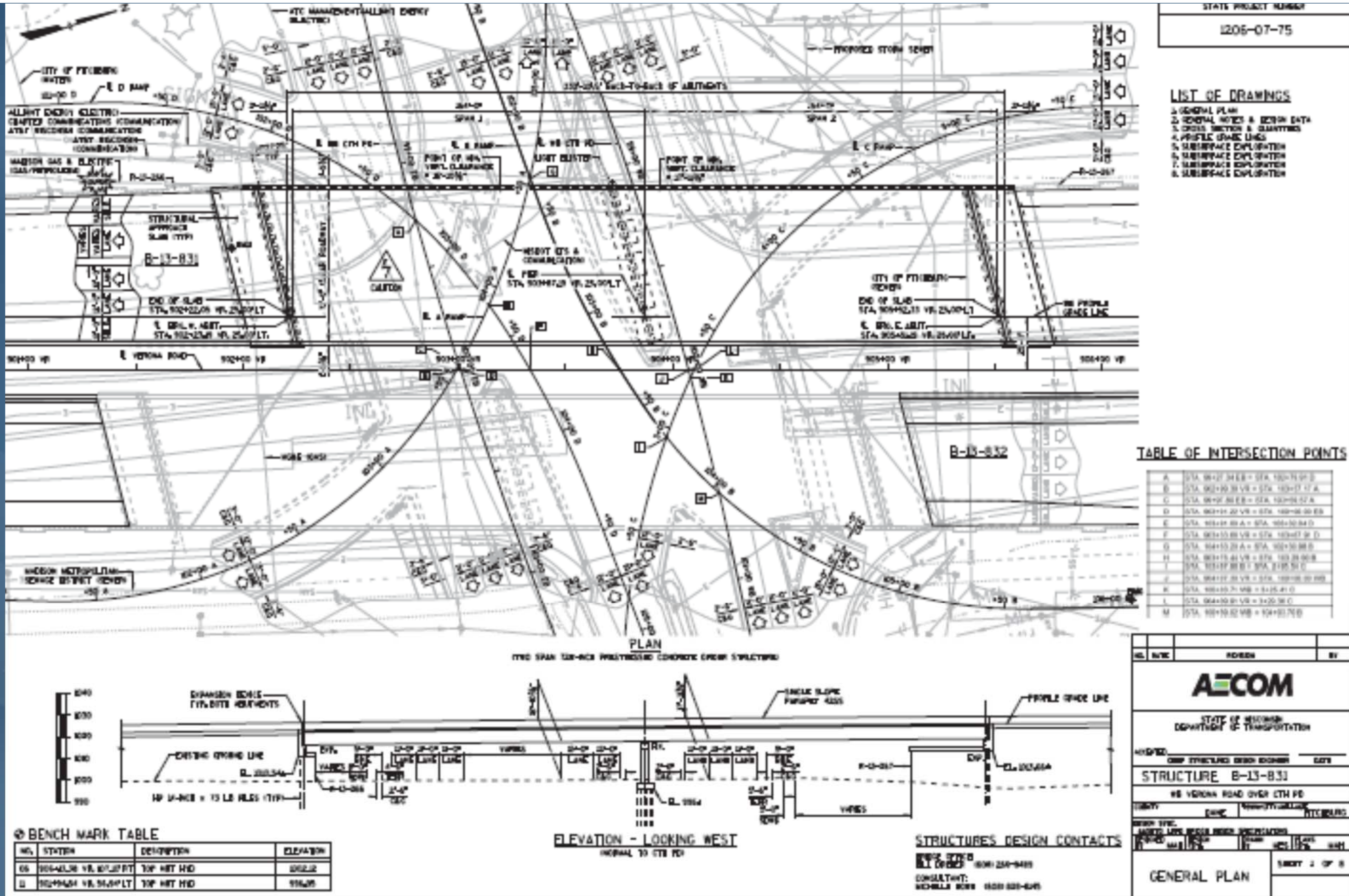
Project Illustration

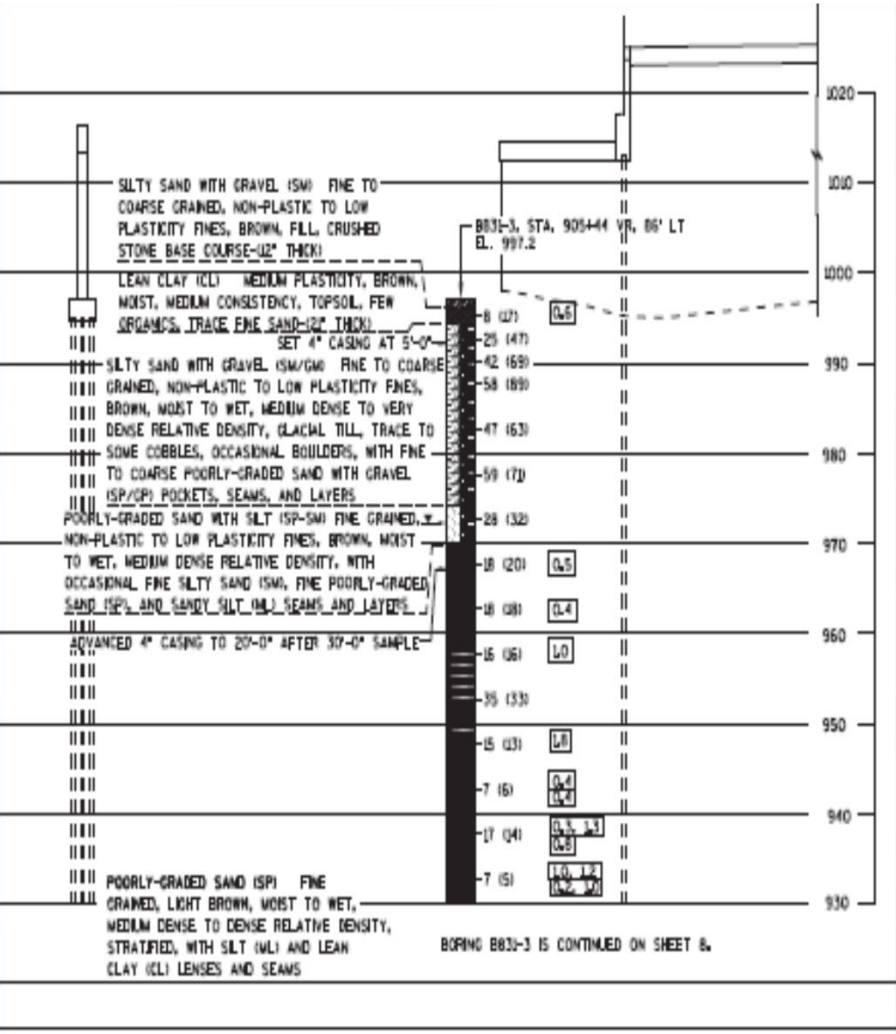
B-13-831/832 USH18/USH 151 over CTH PD

Structure Consultant AECOM

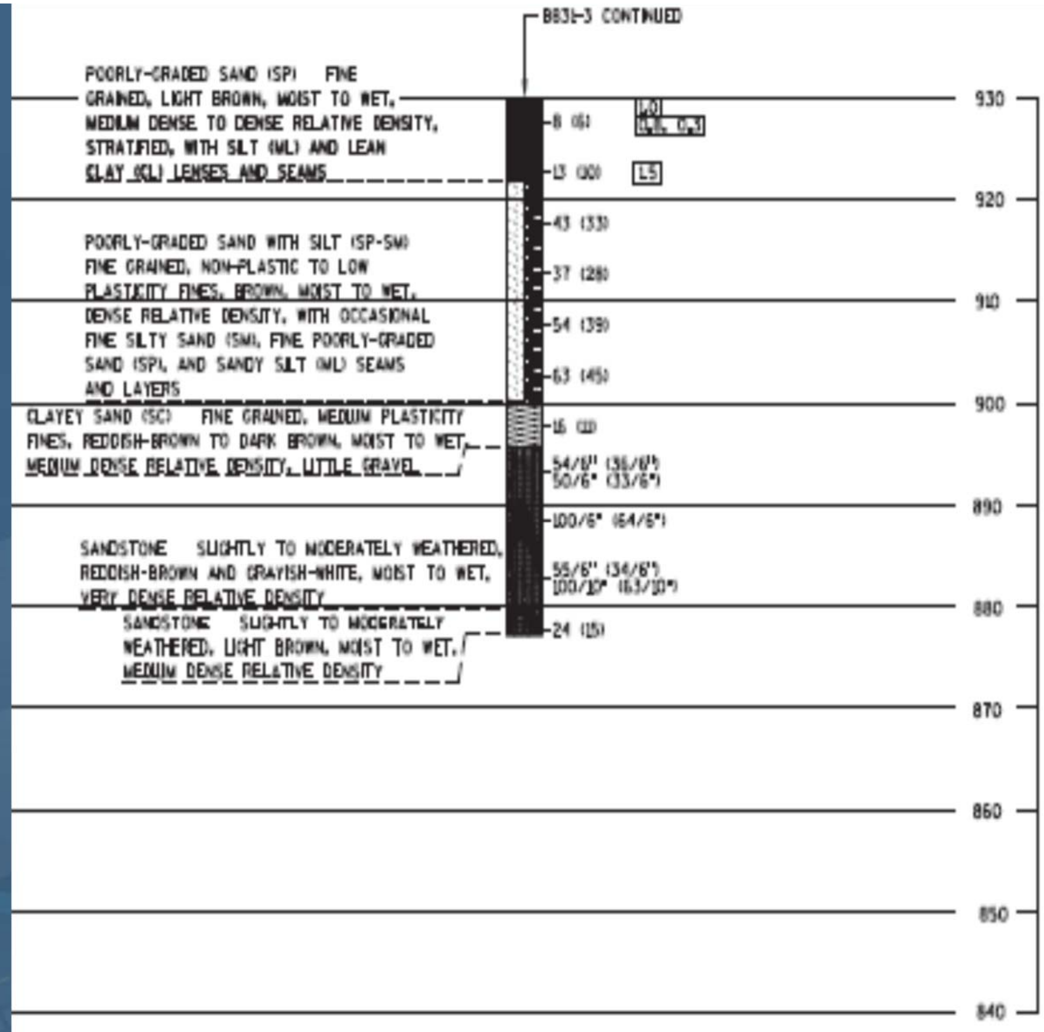
Geotechnical Consultant SOILS & ENGINEERING SERVICES, INC.


SALT SHED LOCATION
EAST VERONA AVENUE
MAPLE GROVE DRIVE
USH 18/151 WB OFF RAMP
USH 18/151 (VERONA ROAD)
SCALE, FEET
FITCHRONA ROAD
CTH PD (MCKEE ROAD)
HARDROCK ROAD
KAPEC ROAD
ANTON DRIVE
NESBITT ROAD
USH 18/151 (VERONA ROAD)
WILLIAMSBURG WAY
RAYMOND ROAD
SPROCKET DRIVE
COMMERCE PARK DRIVE
SPOKE DRIVE
EAST VERON
S-13-452
S-13-457
S-13-456
S-13-453
S-13-445
S-13-446
R-13-268
R-13-267
R-13-264
B-13-831
R-13-269
S-13-444
B-13-832
R-13-266
S-13-442
S-13-454
S-13-455
N-13-0005
S-13-448
S-13-449
R-13-265
S-13-450
S-13-443
S-13-451
B-13-666 TO REMAIN
R-13-242 TO REMAIN
R-13-243 TO REMAIN
B-13-833
R-13-272
R-13-270
R-13-273
R-13-271
S-13-447
PROJECT AREA
Madison
PROJECT NO:1206-07-75
HWY:USH 18
COUNTY:DANE
STRUCTURES OVERVIEW
SHEET
E
WISDOT/CADDS SHEET 42


1206-07-75
LIST OF DRAWINGS
B-13-831
B-13-832
TABLE OF INTERSECTION POINTS
PLAN
AECOM
STRUCTURE B-13-831
BENCH MARK TABLE
ELEVATION - LOOKING WEST
STRUCTURES DESIGN CONTACTS
GENERAL PLAN



SILTY SAND WITH GRAVEL (SM) FINE TO COARSE GRAINED, NON-PLASTIC TO LOW PLASTICITY FINES, BROWN, FILL, CRUSHED STONE BASE COURSE-(12" THICK)
B83I-3, STA. 905+44 VR, 86' LT
EL. 997.2
LEAN CLAY (CL) MEDIUM PLASTICITY, BROWN, MOIST, MEDIUM CONSISTENCY, TOPSOIL, FEW ORGANICS, TRACE FINE SAND-(12" THICK)
SET 4" CASING AT 5'-0"
SILTY SAND WITH GRAVEL (SM/GM) FINE TO COARSE GRAINED, NON-PLASTIC TO LOW PLASTICITY FINES, BROWN, MOIST TO WET, MEDIUM DENSE TO VERY DENSE RELATIVE DENSITY, GLACIAL TILL, TRACE TO SOME COBBLES, OCCASIONAL BOULDERS, WITH FINE TO COARSE POORLY-GRADED SAND WITH GRAVEL (SP/GP) POCKETS, SEAMS, AND LAYERS
POORLY-GRADED SAND WITH SILT (SP-SM) FINE GRAINED, NON-PLASTIC TO LOW PLASTICITY FINES, BROWN, MOIST TO WET, MEDIUM DENSE RELATIVE DENSITY, WITH OCCASIONAL FINE SILTY SAND (SM), FINE POORLY-GRADED SAND (SP), AND SANDY SILT (ML) SEAMS AND LAYERS
ADVANCED 4" CASING TO 20'-0" AFTER 30'-0" SAMPLE
POORLY-GRADED SAND (SP) FINE GRAINED, LIGHT BROWN, MOIST TO WET, MEDIUM DENSE TO DENSE RELATIVE DENSITY, STRATIFIED, WITH SILT (ML) AND LEAN CLAY (CL) LENSES AND SEAMS
BORING B83I-3 IS CONTINUED ON SHEET 8.
1020
1010
1000
990
980
970
960
950
940
930



B83I-3 CONTINUED
POORLY-GRADED SAND (SP) FINE GRAINED, LIGHT BROWN, MOIST TO WET, MEDIUM DENSE TO DENSE RELATIVE DENSITY, STRATIFIED, WITH SILT (ML) AND LEAN CLAY (CL) LENSES AND SEAMS
POORLY-GRADED SAND WITH SILT (SP-SM) FINE GRAINED, NON-PLASTIC TO LOW PLASTICITY FINES, BROWN, MOIST TO WET, DENSE RELATIVE DENSITY, WITH OCCASIONAL FINE SILTY SAND (SM), FINE POORLY-GRADED SAND (SP), AND SANDY SILT (ML) SEAMS AND LAYERS
CLAYEY SAND (SC) FINE GRAINED, MEDIUM PLASTICITY FINES, REDDISH-BROWN TO DARK BROWN, MOIST TO WET, MEDIUM DENSE RELATIVE DENSITY, LITTLE GRAVEL
SANDSTONE SLIGHTLY TO MODERATELY WEATHERED, REDDISH-BROWN AND GRAYISH-WHITE, MOIST TO WET, VERY DENSE RELATIVE DENSITY
SANDSTONE SLIGHTLY TO MODERATELY WEATHERED, LIGHT BROWN, MOIST TO WET, MEDIUM DENSE RELATIVE DENSITY
930
920
910
900
890
880
870
860
850
840

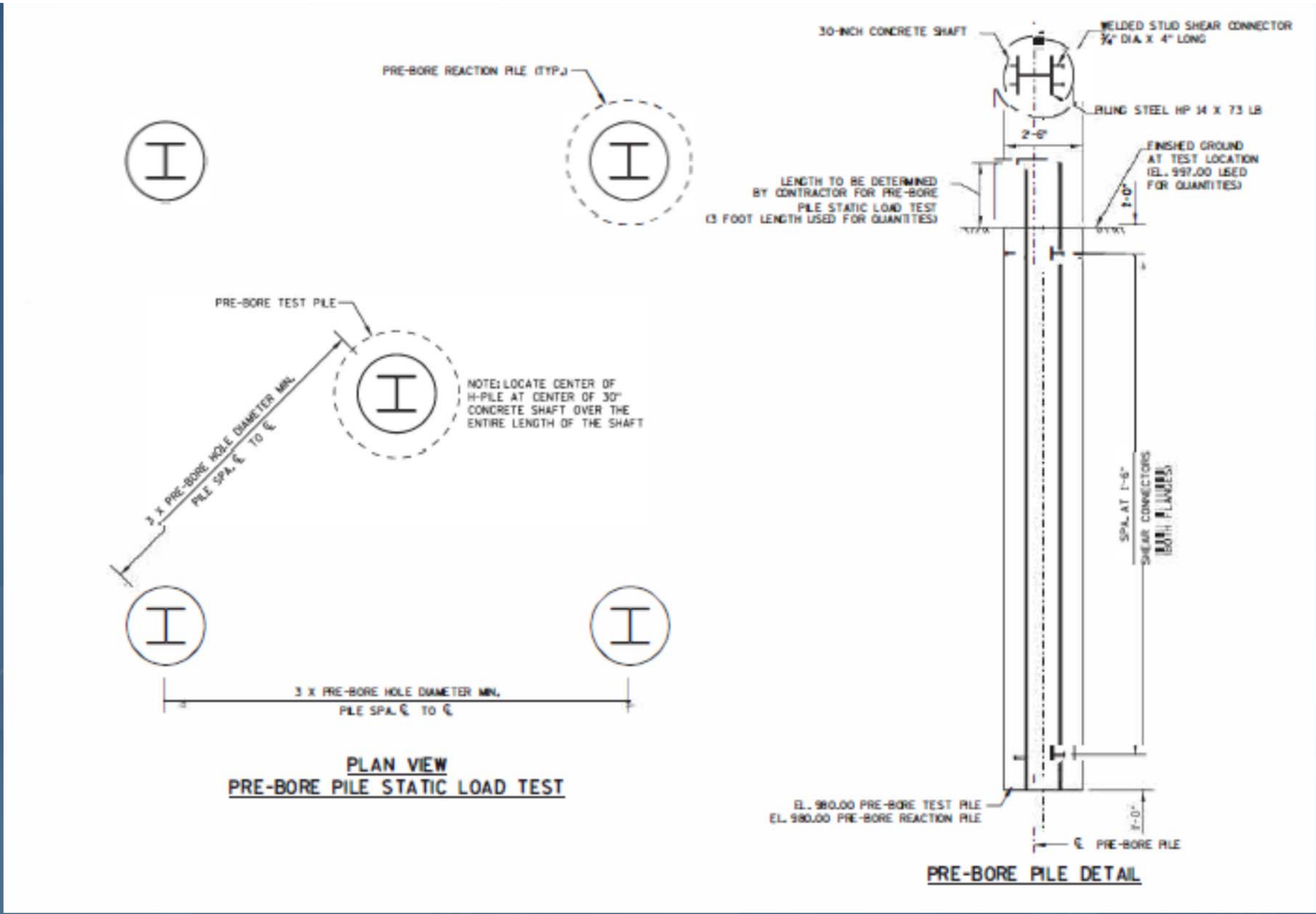
Project Team
Foundation Discussion

<u>Options</u>

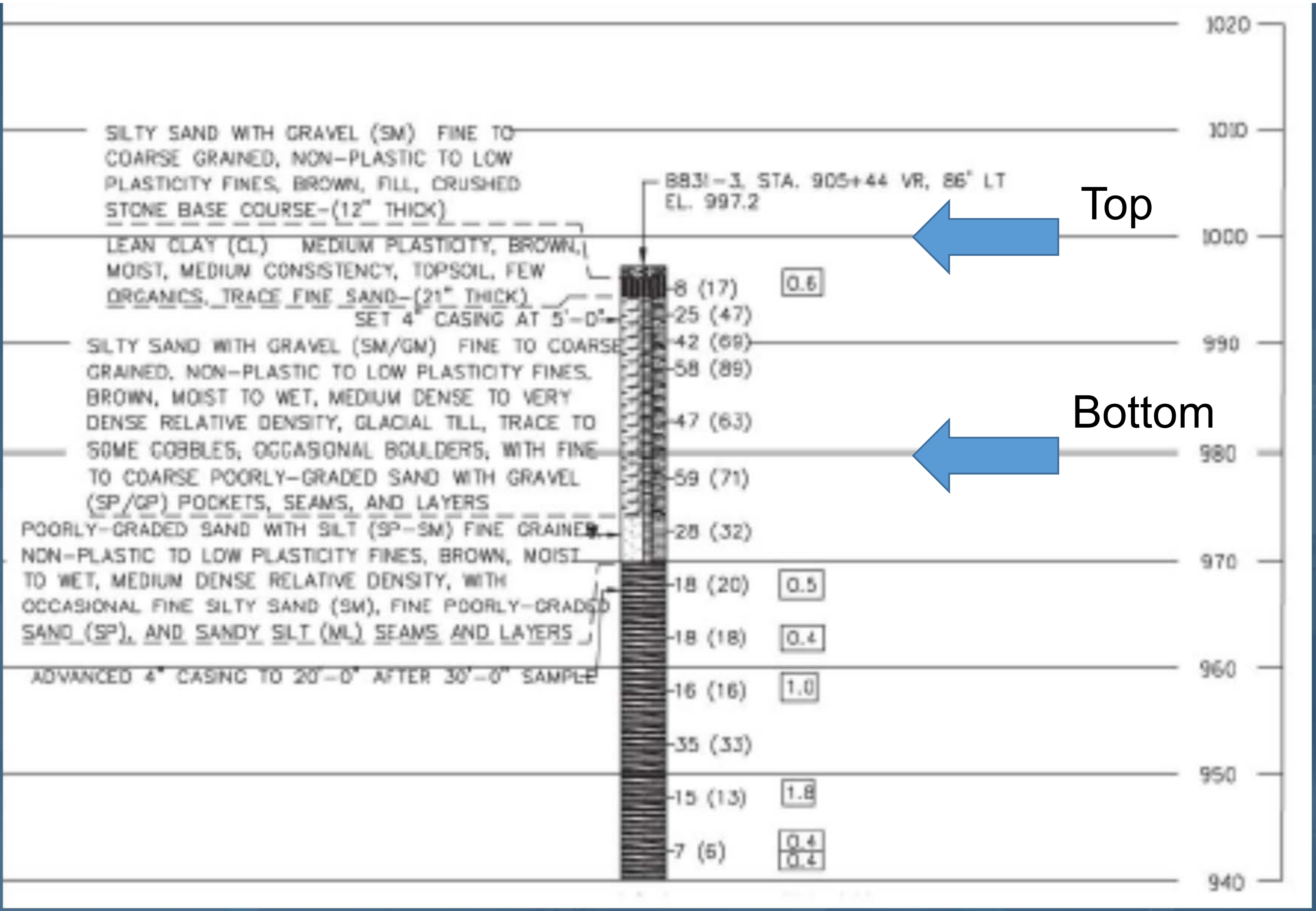
H-piles driven using modified Gates (resistance factor = 0.50)

H-piles driven using Pile Driving Analyzer (resistance factor = 0.65)

Pre-bored H-piles with a Static Load Test (resistance factor = 0.80)



PRE-BORE REACTION PILE (TYP.)
PRE-BORE TEST PILE
3 X PRE-BORE HOLE DIAMETER MIN.
PILE SPA. ℄ TO ℄
NOTE: LOCATE CENTER OF H-PILE AT CENTER OF 30" CONCRETE SHAFT OVER THE ENTIRE LENGTH OF THE SHAFT
PLAN VIEW
PRE-BORE PILE STATIC LOAD TEST
30-INCH CONCRETE SHAFT
WELDED STUD SHEAR CONNECTOR ¾" DIA. X 4" LONG
PILING STEEL HP 14 X 73 LB
2'-6"
FINISHED GROUND AT TEST LOCATION (EL. 997.00 USED FOR QUANTITIES)
LENGTH TO BE DETERMINED BY CONTRACTOR FOR PRE-BORE PILE STATIC LOAD TEST (3 FOOT LENGTH USED FOR QUANTITIES)
1'-0"
SPA. AT 1'-6"
SHEAR CONNECTORS (BOTH FLANGES)
EL. 980.00 PRE-BORE TEST PILE
EL. 980.00 PRE-BORE REACTION PILE
1'-0"
℄ PRE-BORE PILE
PRE-BORE PILE DETAIL


1020
1010
1000
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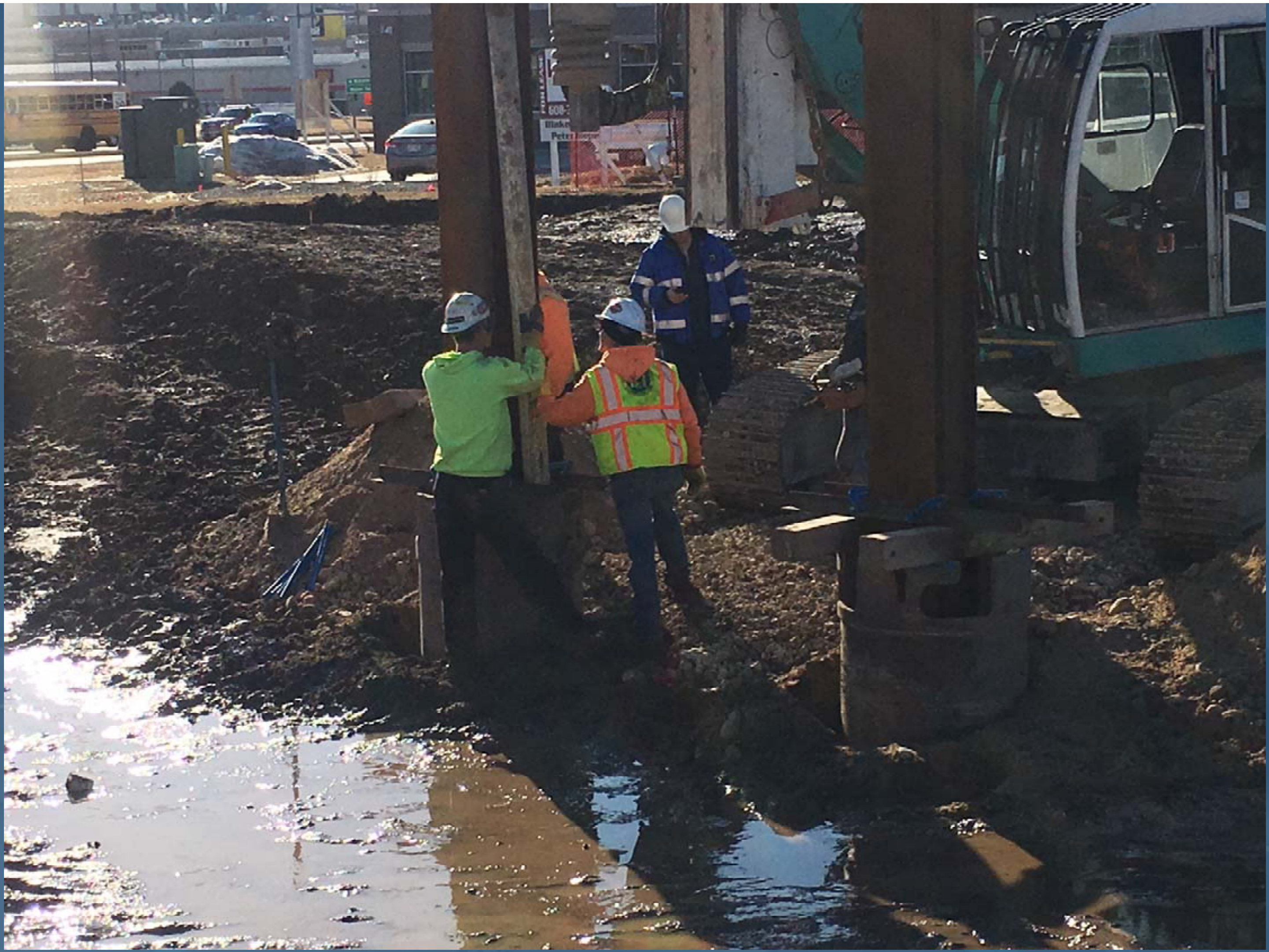
940
SILTY SAND WITH GRAVEL (SM) FINE TO COARSE GRAINED, NON-PLASTIC TO LOW PLASTICITY FINES, BROWN, FILL, CRUSHED STONE BASE COURSE-(12" THICK)
LEAN CLAY (CL) MEDIUM PLASTICITY, BROWN, MOIST, MEDIUM CONSISTENCY, TOPSOIL, FEW ORGANICS, TRACE FINE SAND-(21" THICK)
SET 4" CASING AT 5'-0"
SILTY SAND WITH GRAVEL (SM/GM) FINE TO COARSE GRAINED, NON-PLASTIC TO LOW PLASTICITY FINES, BROWN, MOIST TO WET, MEDIUM DENSE TO VERY DENSE RELATIVE DENSITY, GLACIAL TILL, TRACE TO SOME COBBLES, OCCASIONAL BOULDERS, WITH FINE TO COARSE POORLY-GRADED SAND WITH GRAVEL (SP/GP) POCKETS, SEAMS, AND LAYERS
POORLY-GRADED SAND WITH SILT (SP-SM) FINE GRAINED, NON-PLASTIC TO LOW PLASTICITY FINES, BROWN, MOIST TO WET, MEDIUM DENSE RELATIVE DENSITY, WITH OCCASIONAL FINE SILTY SAND (SM), FINE POORLY-GRADED SAND (SP), AND SANDY SILT (ML) SEAMS AND LAYERS
ADVANCED 4" CASING TO 20'-0" AFTER 30'-0" SAMPLE
B831-3 STA. 905+44 VR, 86' LT
EL. 997.2
8 (17)
25 (47)
42 (69)
58 (89)
47 (63)
59 (71)
28 (32)
18 (20)
18 (18)
16 (16)
35 (33)
15 (13)
7 (6)
0.6
0.5
0.4
1.0
1.8
0.4
0.4
Top
Bottom


02/26/2018


02/26/2018

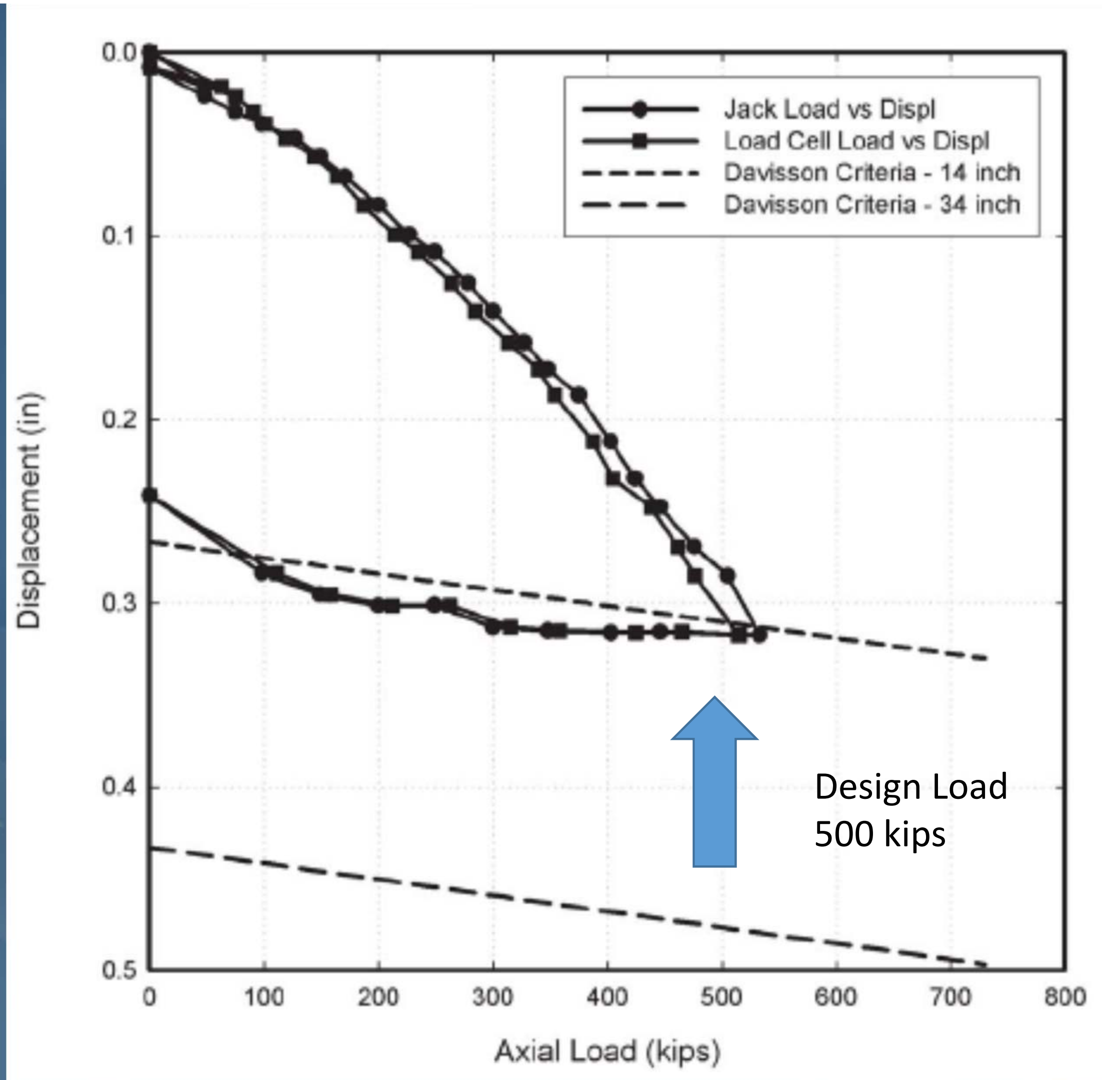


BUREAU OF STRUCTURES

BUREAU OF STRUCTURES


42,400 #


300
TON


Jack Load vs Displ
Load Cell Load vs Displ
Davisson Criteria - 14 inch
Davisson Criteria - 34 inch
Displacement (in)
0.0
0.1
0.2
0.3
0.4
0.5
0
100
200
300
400
500
600
700
800
Axial Load (kips)
Design Load
500 kips

Questions

BOS Overlay Policy

James Luebke
Structural Development Engineer

2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

May 22, 2018

BUREAU OF STRUCTURES

Current Bridge Manual

- Bridge Manual
  - Section 40.5 – Deck Overlays
    - Guidelines
    - Methods
    - Miscellaneous Item


WisDOT Bridge Manual
Chapter 40 – Bridge Rehabilitation

3 pages

Overlay Methods

- Active
  - Thin Polymer
  - Low Slump Concrete
- Less Active
  - Polymer Modified Asphaltic
  - Polyester Polymer
  - Asphaltic
- Not Active
  - Asphaltic with Membrane

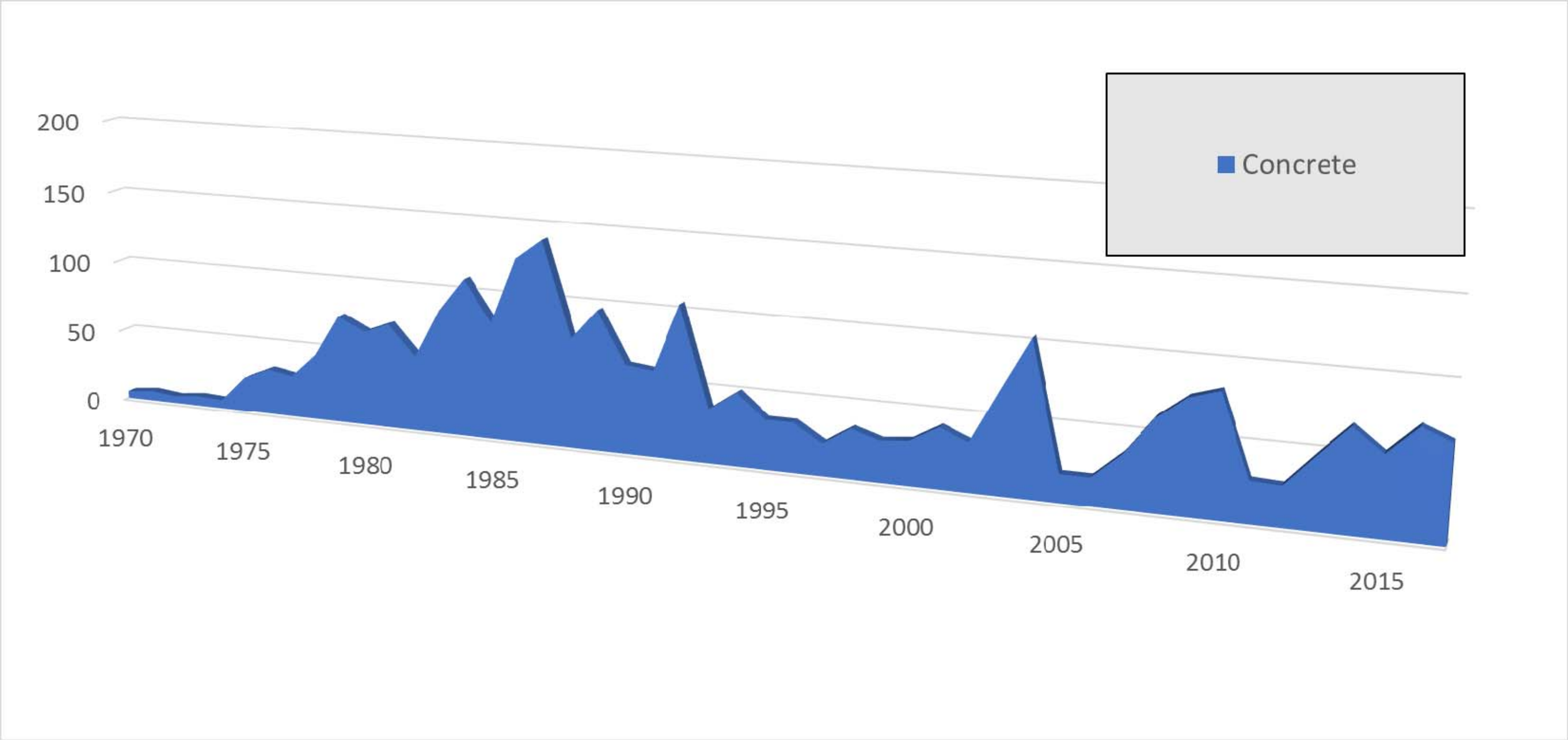
Thin Polymer Overlay
(Preservation)

Concrete Overlay
(Rehabilitation)

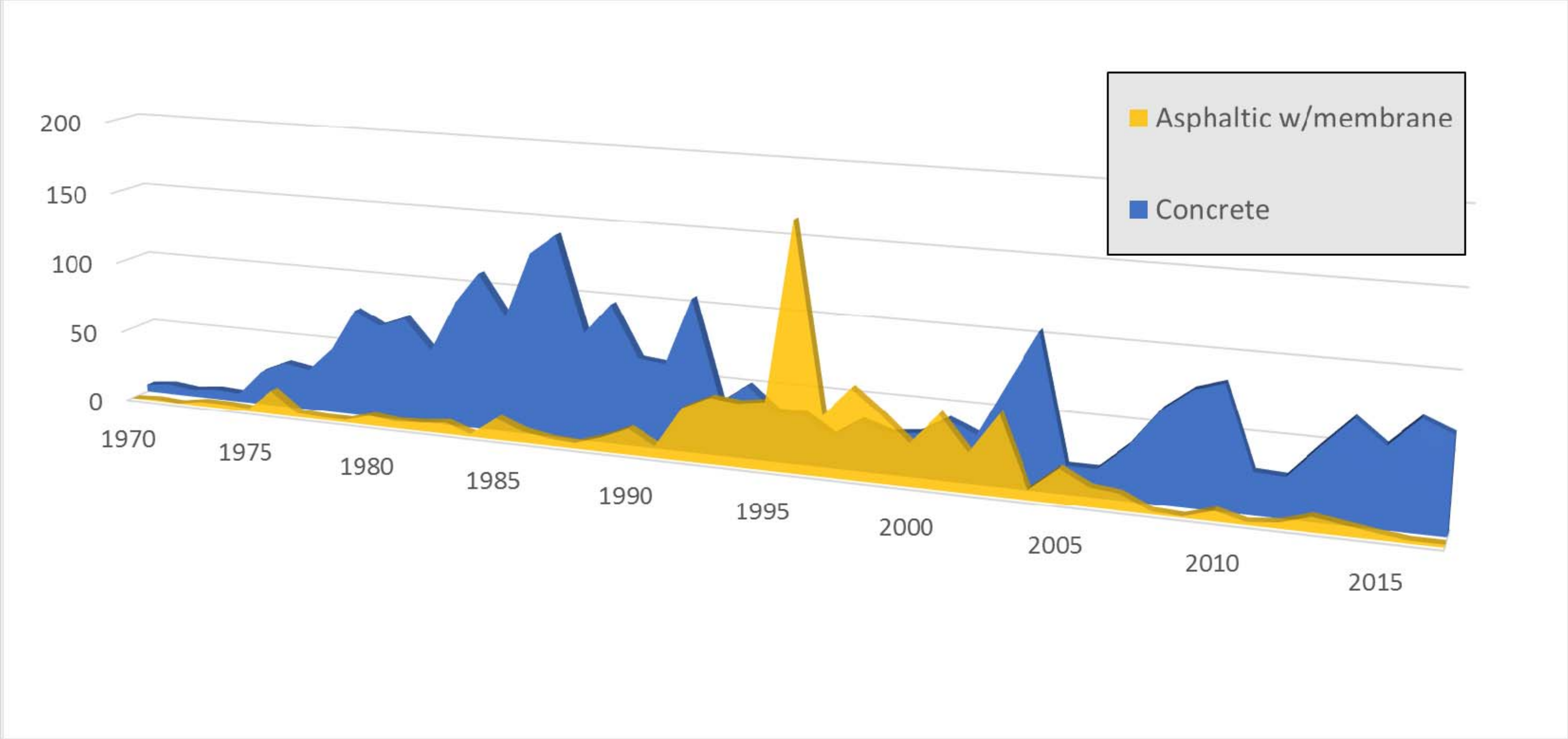
Overlay Methods

- Further Developments
  - Polyester Polymer
  - Asphaltic with Membrane
  - Latex Modified Concrete
- Further Guidance
  - WiSAMS (Wisconsin Structures Asset Management System)
  - Bridge Manual
  - Standard Details
  - Specifications

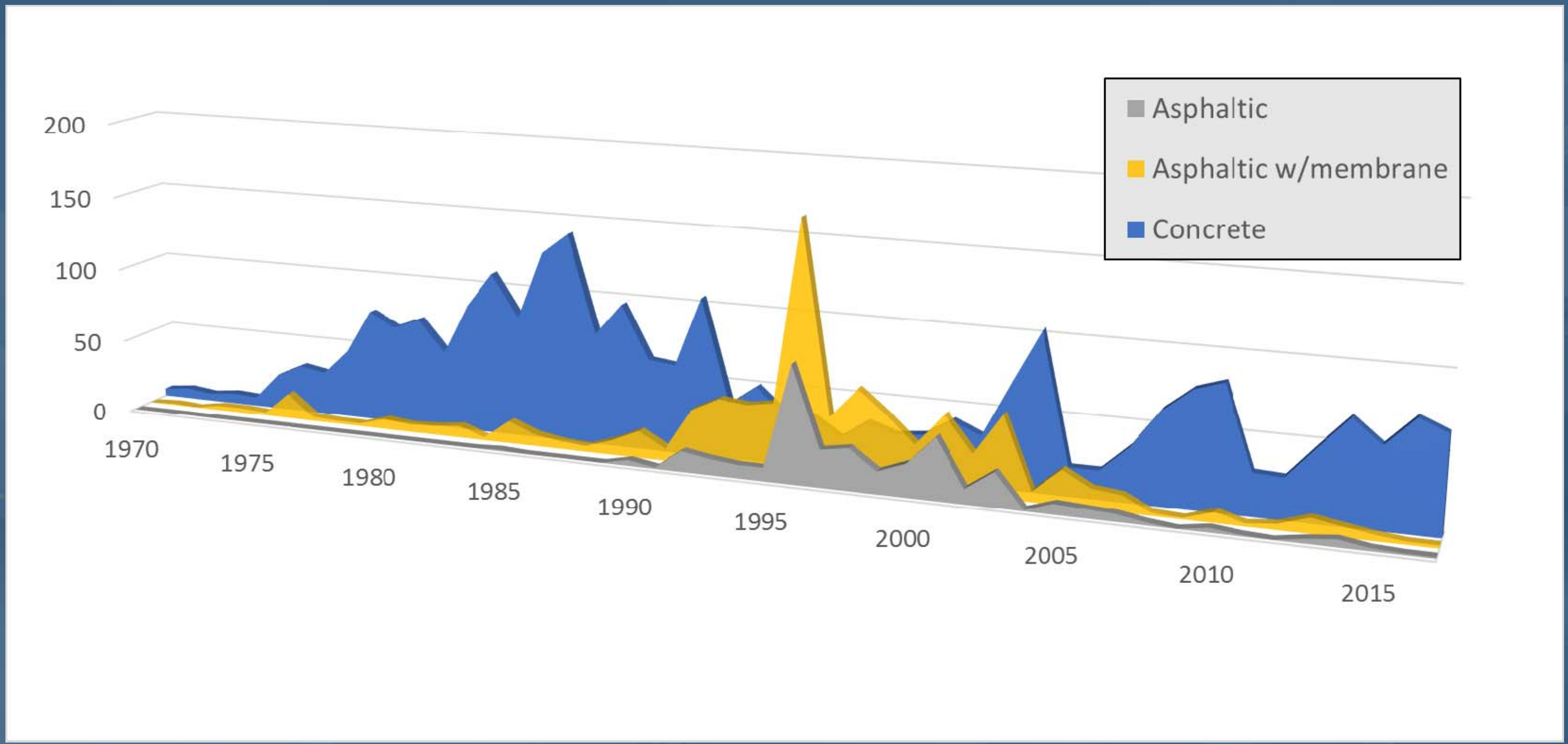
Past Overlay Usages



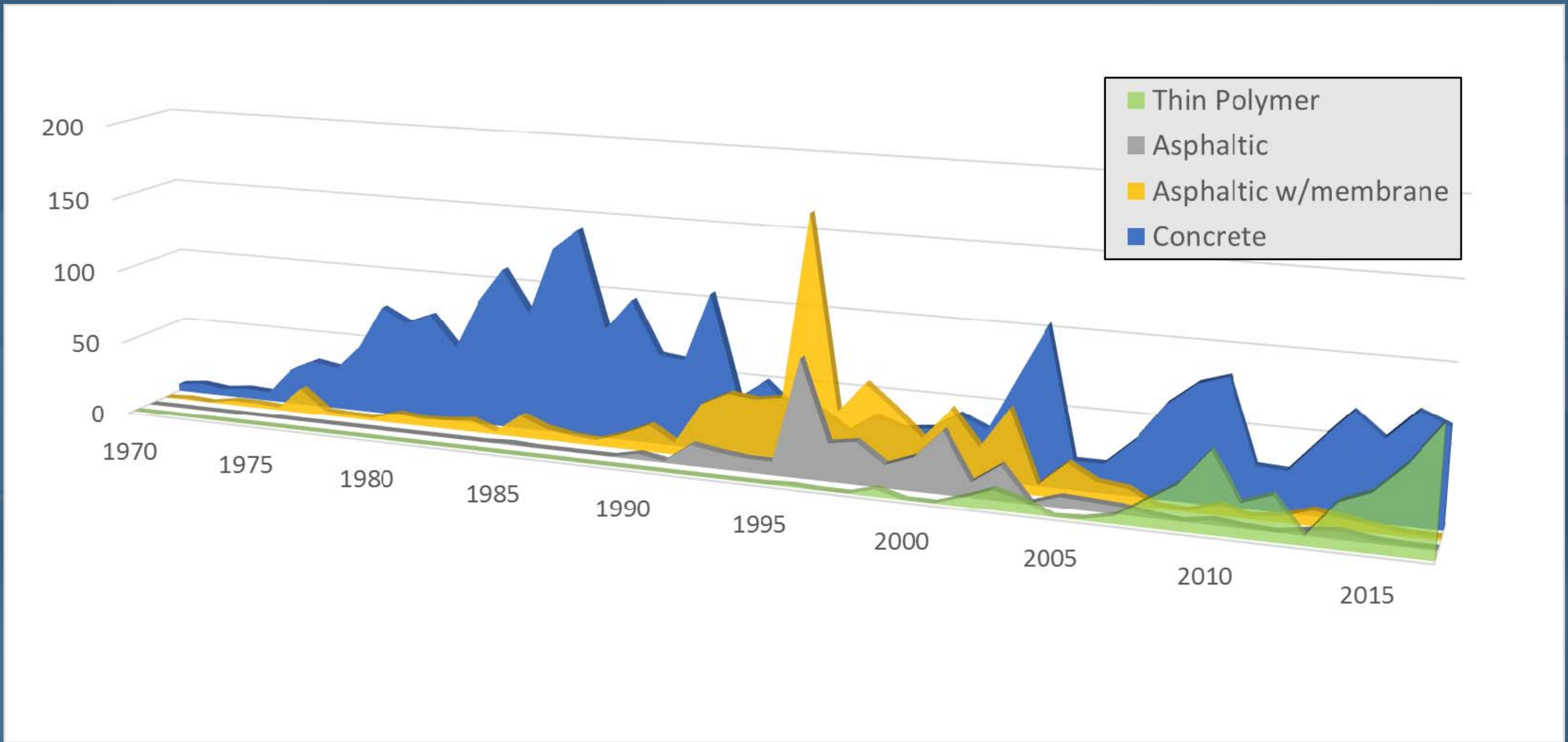
Past Overlay Usages



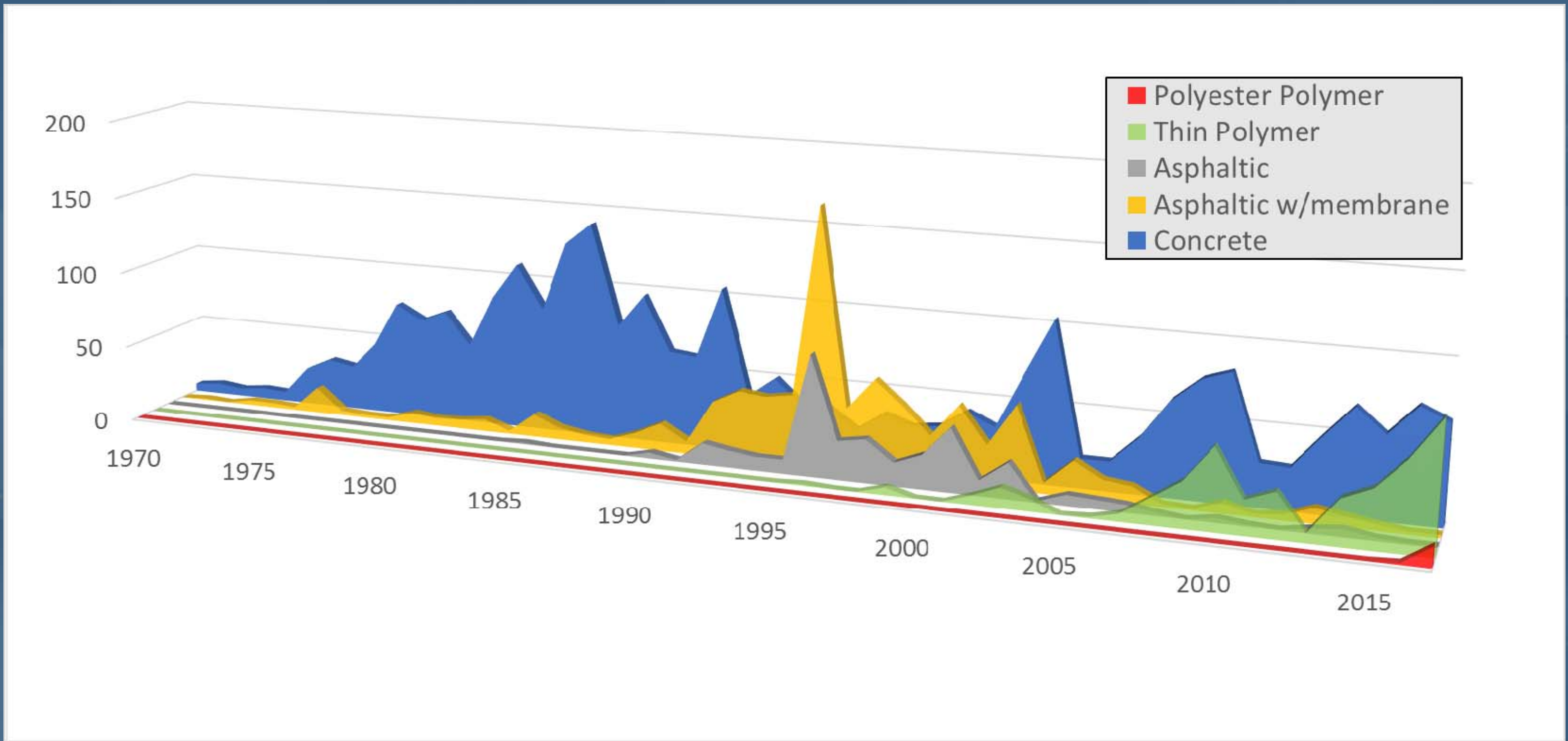
Past Overlay Usages



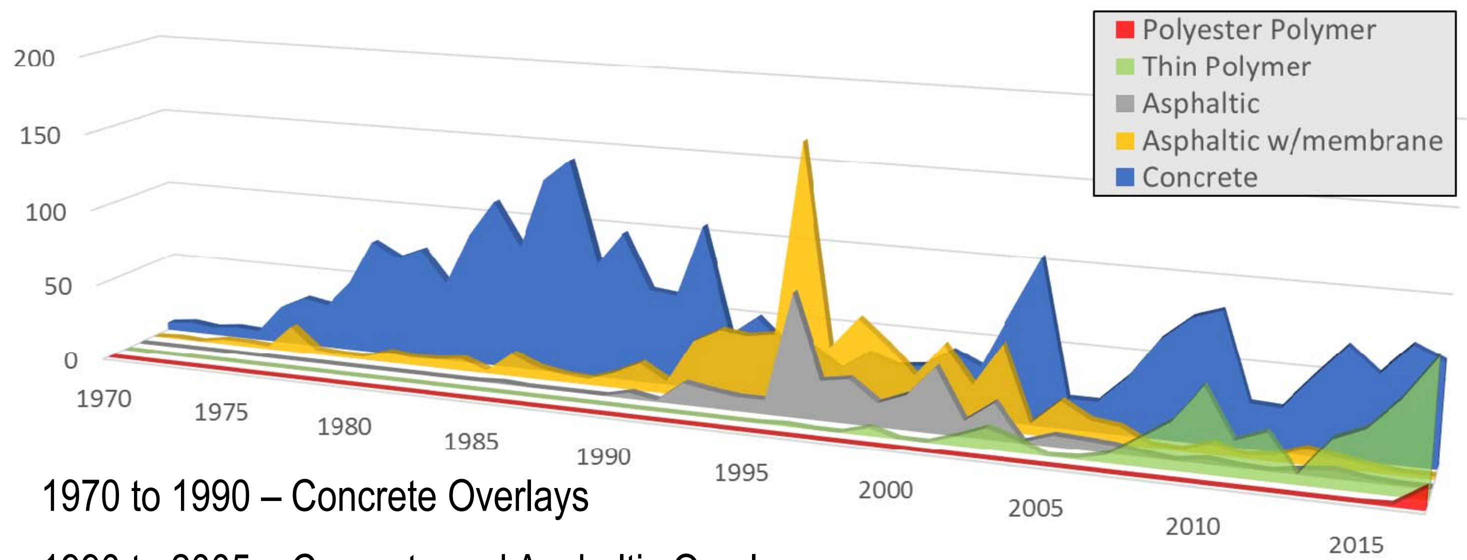
Past Overlay Usages



Past Overlay Usages

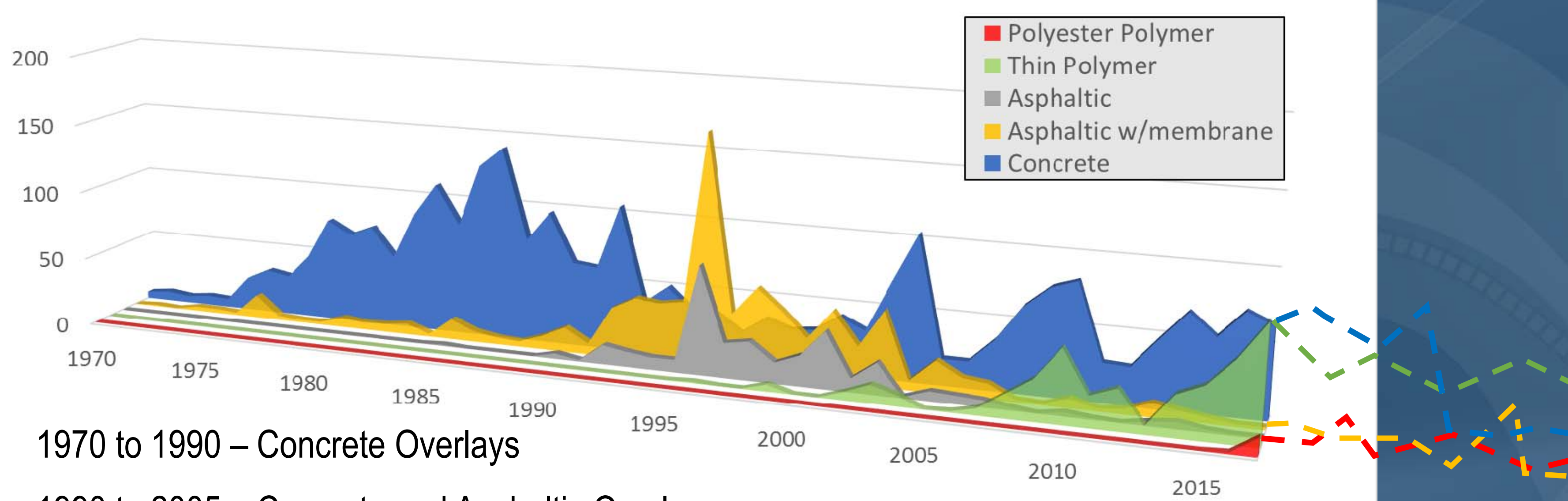


Past Overlay Usages



- 1970 to 1990 – Concrete Overlays
- 1990 to 2005 – Concrete and Asphaltic Overlays
- 2005 to Present – Concrete and Polymer Overlays

Past Overlay Usages



- 1970 to 1990 – Concrete Overlays
- 1990 to 2005 – Concrete and Asphaltic Overlays
- 2005 to Present – Concrete and Polymer Overlays

Source: HSI (Ryan Bowers)

Updated Bridge Manual

- Bridge Manual
  - Section 40.5 – Deck Overlays
    - Methods
    - Selection Considerations
    - Background Information

20+ pages

Overlay Type	Advantages	Disadvantages	Notes
Thin Polymer Overlay	• Minimal dead load • Minimal traffic disruptions • Seals the deck • Provides traction	• Requires a concrete age of at least 21 days • Requires decks with minimal defects and low chloride concentrations • Sensitive to moisture, temperature, and humidity at placement • Reflective cracking concerns	
Low Slump Concrete Overlay	• Contractor familiarity and department experience • Long life span potential • Durable • Ease to accommodate grade differences and deficiencies	• Traffic disruptions • Additional dead load • High maintenance requirements • Railing height concerns • Susceptible to cracking • Specialized finishing equipment	• May require crack sealing the following year and periodically thereafter.
Polyester Polymer Concrete Overlay	• Minimal dead load • Minimal traffic disruptions • Seals the deck • Provides traction • Long life span potential • Durable • Low maintenance requirements	• High cost • Dedicated equipment • Limited usage in Wisconsin • Sensitive to moisture, temperature, and humidity at placement • Reflective cracking concerns	• Requires BOS Prior-Approval
Polymer Modified Asphaltic Overlay	• Minimal traffic disruptions • Ease to construct • Can be used on more flexible structures (e.g. timber decks or timber slabs)	• High cost • Susceptible to permeability • Difficult to assess top of deck condition	• Contact region for availability • Minimal research has been performed on the durability of this system in Wisconsin
Asphaltic Overlay	• Low cost • Ease to construct • Ease to accommodate grade differences and deficiencies	• Short life span • Not eligible for federal funds • Overlay permeability • Difficult to assess top of deck condition	• Deck or bridge replacement should be programmed within 4 years
Asphaltic Overlay with Membrane	• Ease to construct • Minimal traffic disruptions • Long life span potential • Can be used on more flexible structures (e.g. PS box girders)	• Susceptible to permeability • Requires a membrane • Difficult to assess top of deck condition	• Currently under review • Requires BOS Prior-Approval

Table 40.5-2
Overlay Advantages, Disadvantages, and Notes

Overlay Advantages, Disadvantages, and Notes

40.5.3 Deck Assessment

The following are common deck assessment tools that can be used to survey existing deck conditions:

- Inspection reports
- Infrared thermography - Infrared Thermography (IR) is an alternative tool for locating and mapping delaminations in bridge decks and pavements. A technique using an infrared scanner and control video camera, infrared thermography senses temperature differences between delaminated and non-delaminated areas.

Polyester Polymer Overlay Usage

- Decks in Good Condition
  - NBI rating of 7 or greater
  - Distressed areas < 5%
  - Less than 15 years* old deck
- General Criteria
  - Traffic Restrictions
  - High Traffic (AADT > 20,000)
  - Remaining life > 20 years

New System
Restrictive Usage

Polyester Polymer Overlay Usage

- Decks in Good Condition
  - NBI rating ≥ 7
  - Distressed areas < 5%
  - Deck age <15 years*
- General Criteria
  - Traffic Restrictions
  - High Traffic (AADT > 20,000)
  - Remaining life > 20 years

Thin Polymer Overlays

- NBI rating > 7
- Distressed areas < 2%
- Deck age < 10 years*
- No General Restrictions

Overlay Policy

- Overlay Selection
- Resources
  - Region
  - Bridge Manual
  - BOS
- Coordination

INPUT:
- Structure Type
- Structure Response
- AADT
- Design Speed
- Chloride Content
- Concrete Permeability
- Concrete Cover
- Lane Restrictions
- Ratings
- Funding
- Contract Efficiencies
- Existing Overlay

OUTPUT:
- Low Slump Polymer Overlay

WisDOT Structural Engineers Symposium

May 22, 2018

Marquette Interchange PPC Overlays

Presented by:

Jason Sadowski, PE, SE

WISCONSIN DEPARTMENT OF TRANSPORTATION BUREAU OF STRUCTURES

Michael Baker INTERNATIONAL

Agenda

- Project Overview
- Bridge Preservation
- What is PPC and why use it?
- Marquette Interchange Project
- Construction
- Conclusion

Project Overview

Marquette Interchange Scope

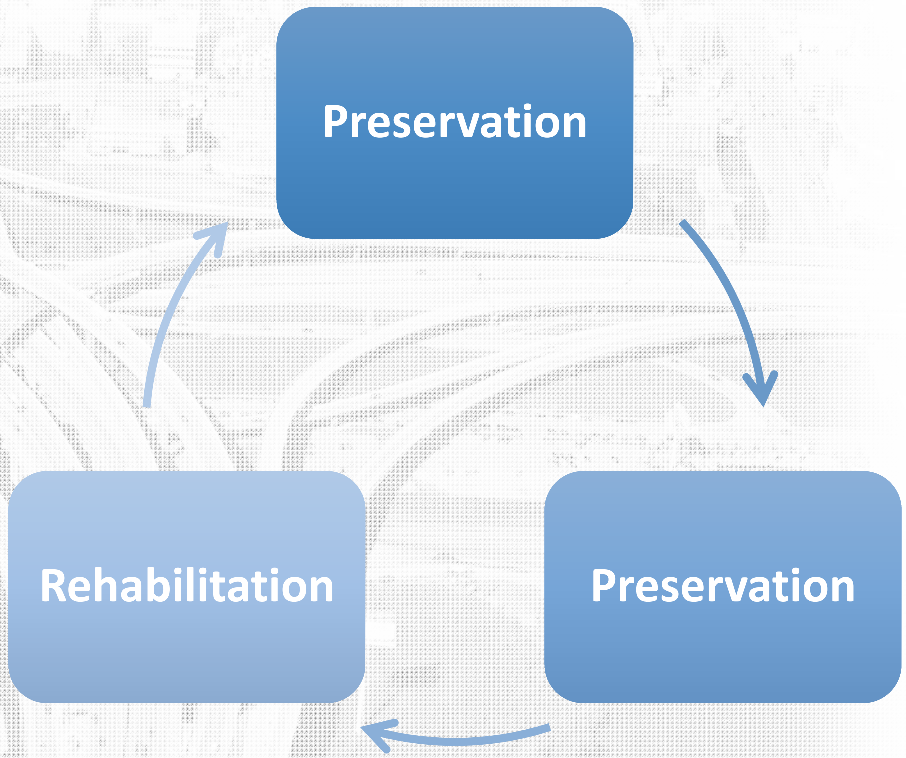
- PPC overlay
- Lighting upgrade to LED
- ITS
- Splice plate painting

Valley Bridge Scope

- Concrete overlay

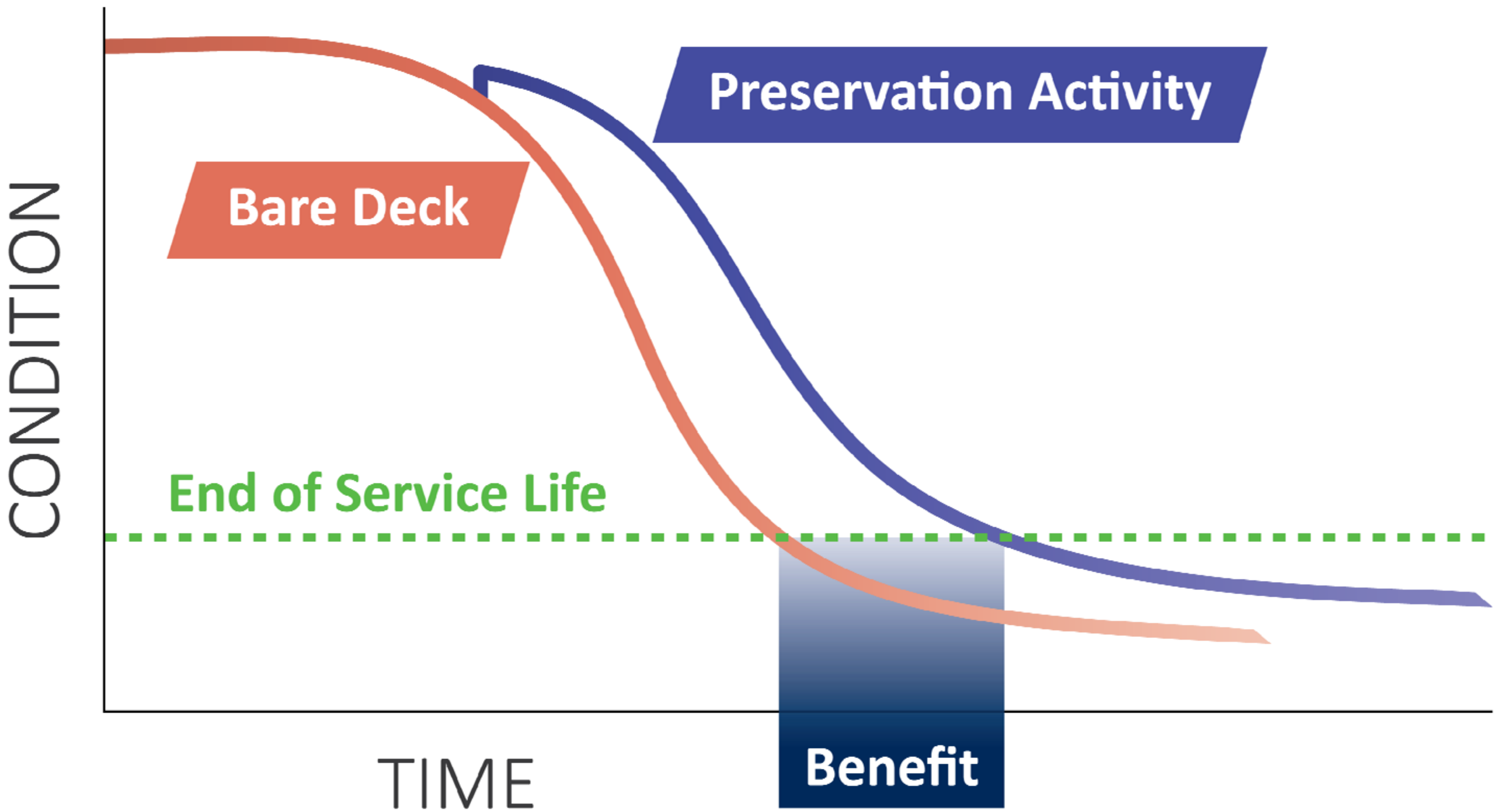
What is Bridge Preservation?

- Extend service life
- Limit traffic impacts
- Optimize life cycle costs
- Cyclical activity



What is Bridge Preservation?

Michael Baker INTERNATIONAL

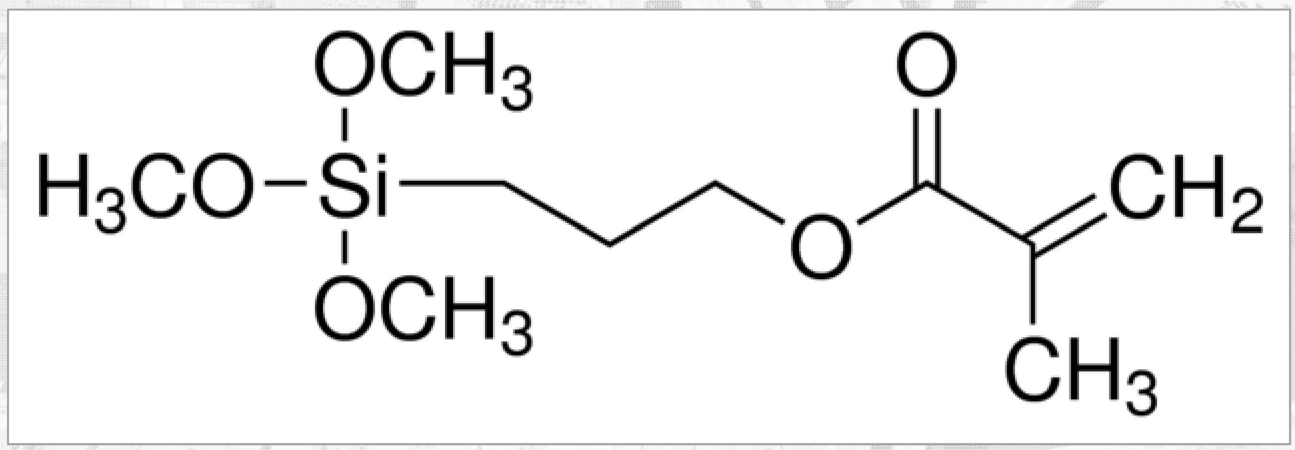


What is PPC and why use it?

Michael Baker INTERNATIONAL

Polyester Polymer Concrete

- Binder
- Aggregate
- Sealing Primer



"Gammamethacryloxypropyltrimethoxysilane"

What is PPC and why use it?

Michael Baker
INTERNATIONAL

Pros

- Impermeable seal
- Fast cure – all temps
- Durability
- Friction

What is PPC and why use it?

Michael Baker INTERNATIONAL

Cons

- Cost ($10-$12 / sf)
- Few local contractors
- Fast cure

Identify the right projects!

What is PPC and why use it?

PPC	Thin Polymer
Single course	Two course
3/4” minimum	3/8” typical
Impermeable	Mostly impermeable
20-30 year life	10-15 year life
2 – 4 hour cure	4 – 14 hour cure
Shotblast CSP 5	Shotblast CSP 5
$10-12/sf	$3/sf

Marquette Interchange PPC Specification

Michael Baker
INTERNATIONAL

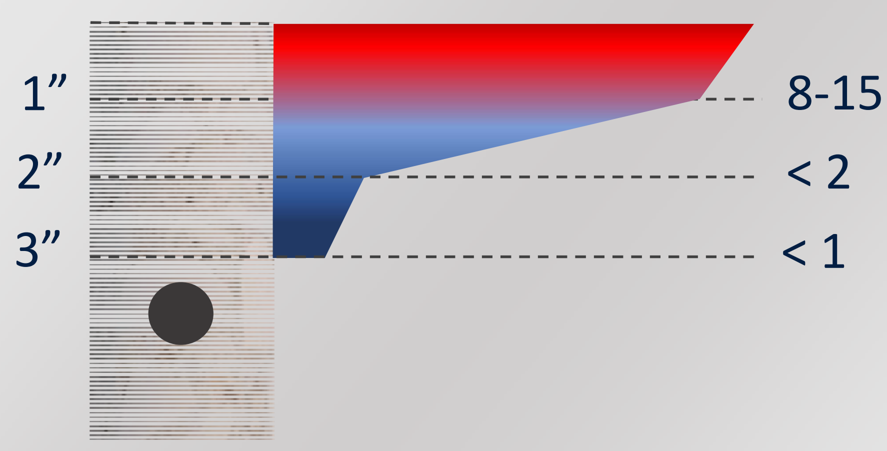
- Co-operative effort
- Experience requirements
- Bond critical performance
- ¾” milling (optional)

Marquette Interchange Structural Design

Michael Baker INTERNATIONAL

BOS Criteria

- ✓ Preservation project
- ✓ Age 10 years +/-
- ✓ Avg. NBI 6.7
- ✓ Deck distress < 1%
- ✓ Chloride profile
  (5 lb limit at rebar)
- ✓ Traffic volume
- ✓ Key infrastructure

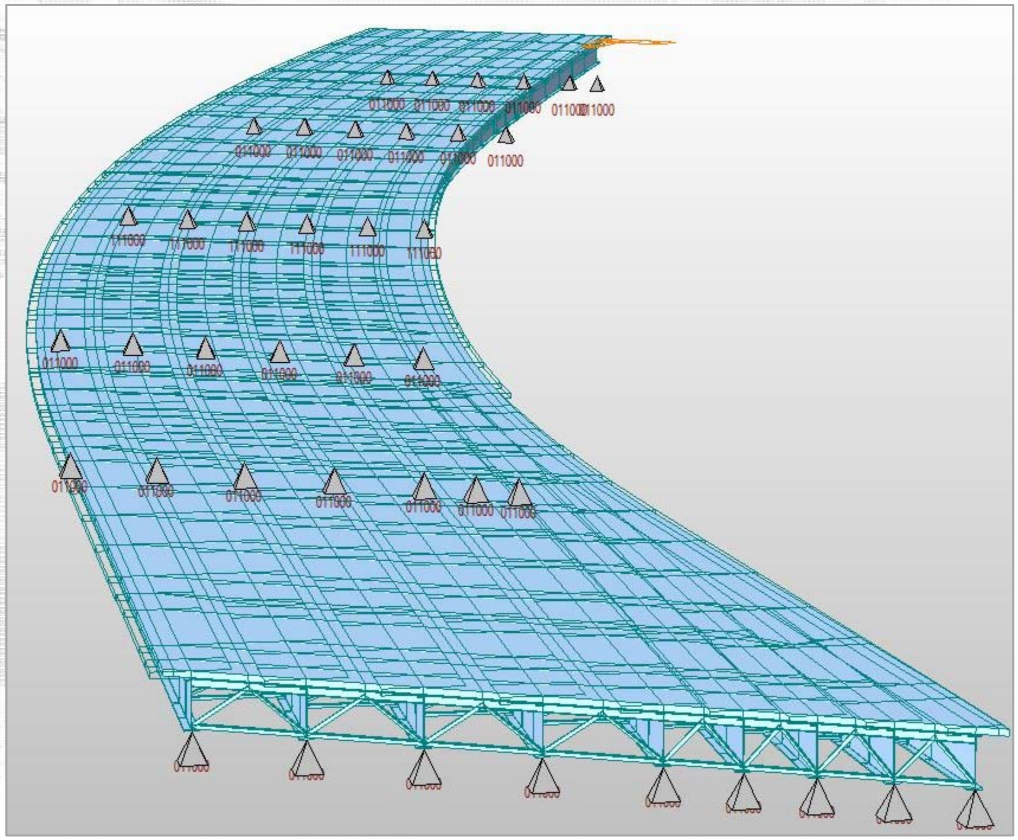


Typical Chloride Levels (lb/cy)

Marquette Interchange Structural Design

Michael Baker INTERNATIONAL

- Complex load rating
- Variable cross slopes & super-elevations
- Traffic control
- Joint locations

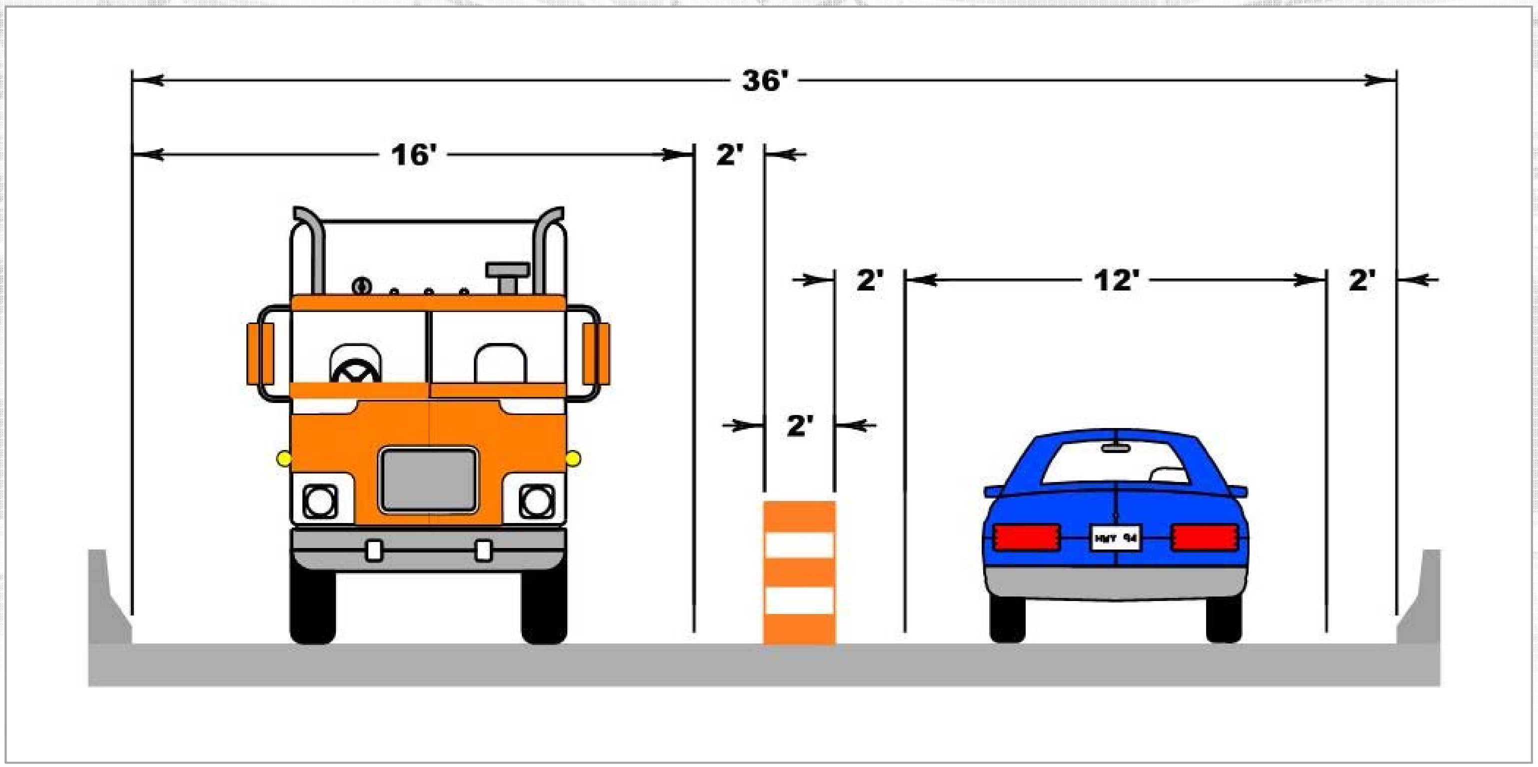


Marquette Interchange Traffic Control

Michael Baker INTERNATIONAL

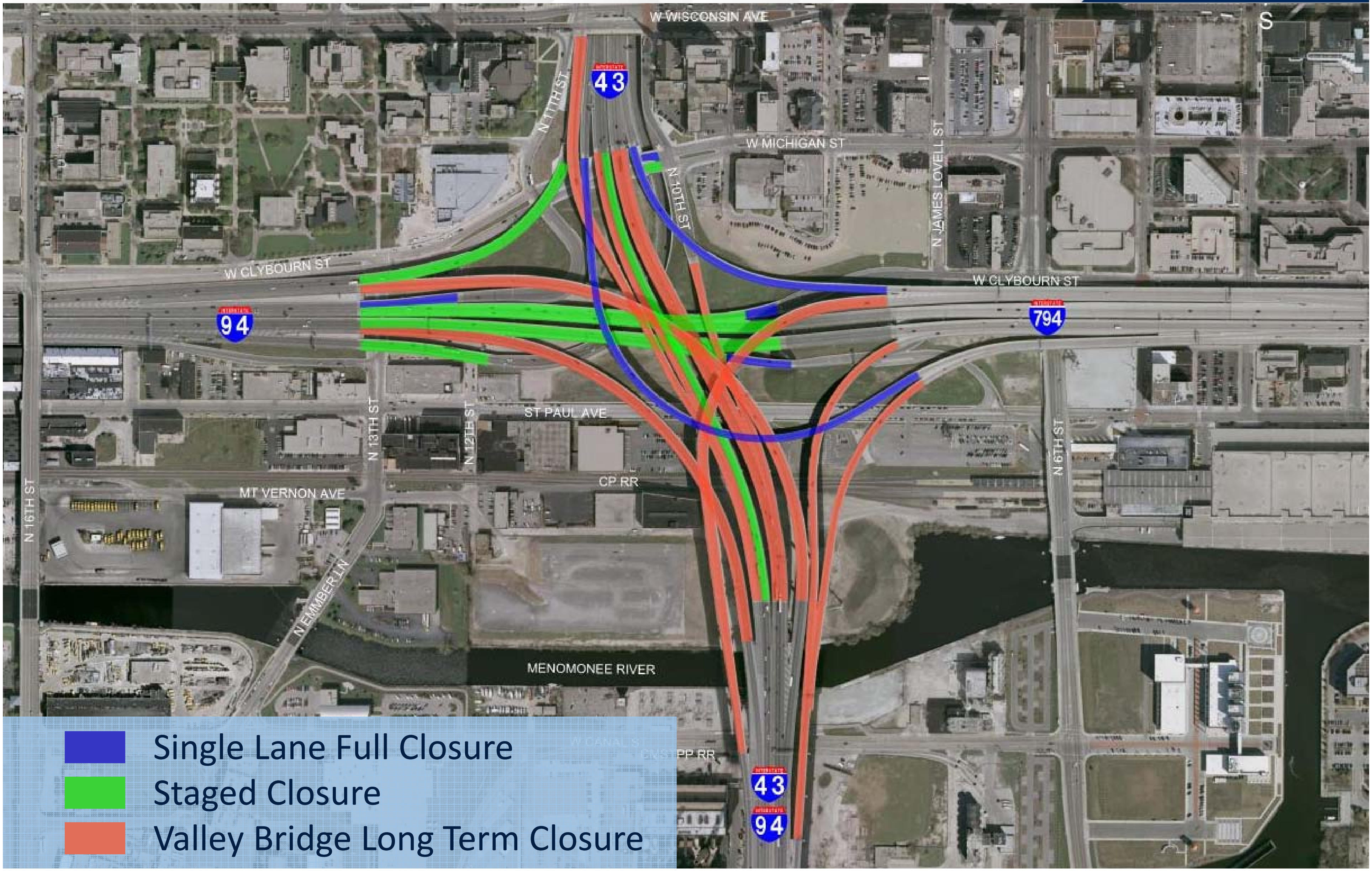
Staged vs. Full Closure

- 16’ clear zone for PPC equipment
- Min roadway width = 36’ for staged construction



Marquette Interchange Traffic Control

Michael Baker INTERNATIONAL



Single Lane Full Closure

Staged Closure

Valley Bridge Long Term Closure

PPC Construction Preparation

Michael Baker INTERNATIONAL

Milling
- In advance of PPC
- Added PPC quantity
- Profile milling

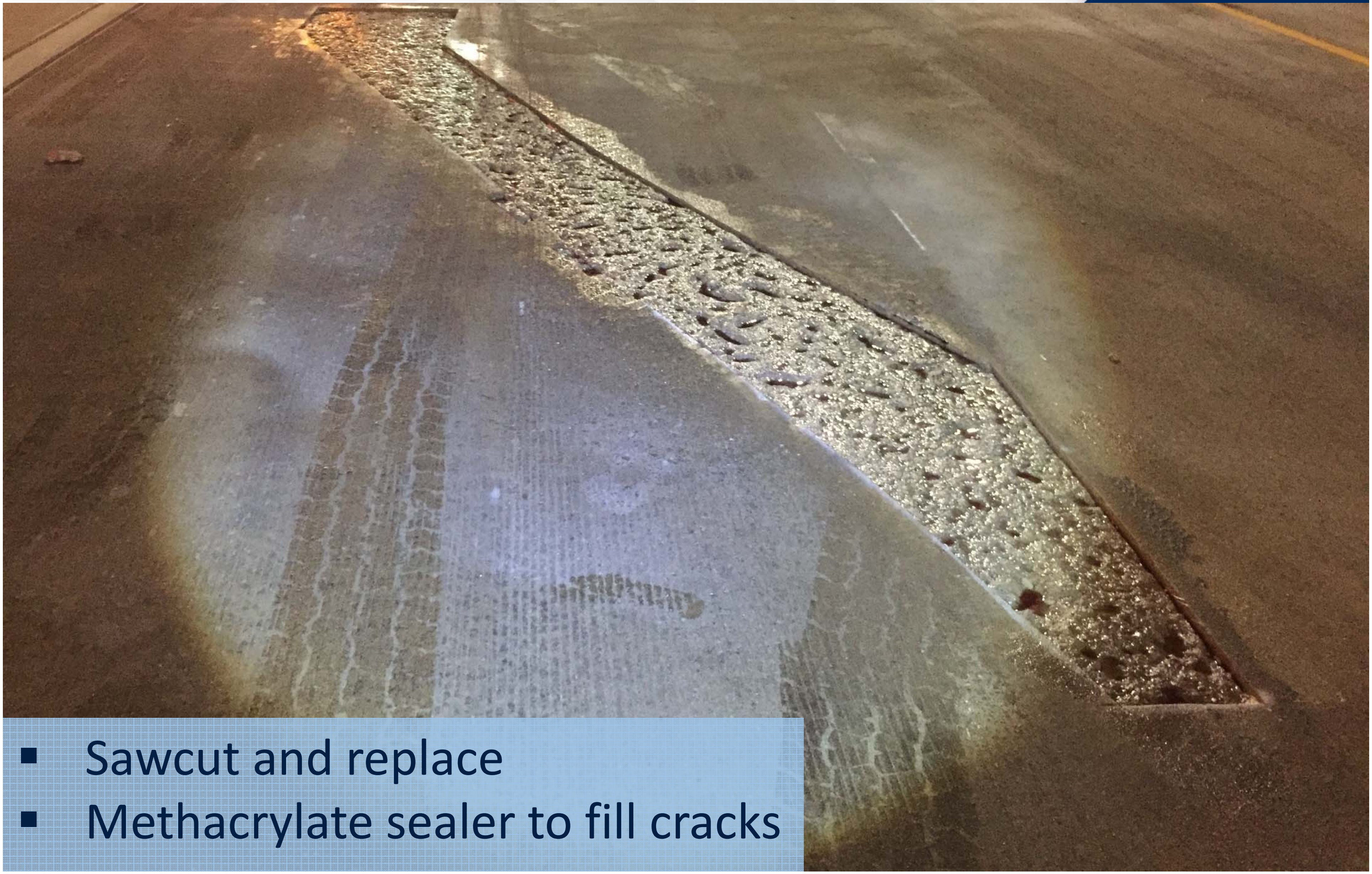
Shot blasting
- 48” blaster – 6,000 sf/hr
- Spot cleaning

PPC Construction Placement

Michael Baker
INTERNATIONAL

- 2,000’ per night
- Place uniform thickness
- Keep the paver moving
- Hardness testing

PPC Construction Spot Repairs

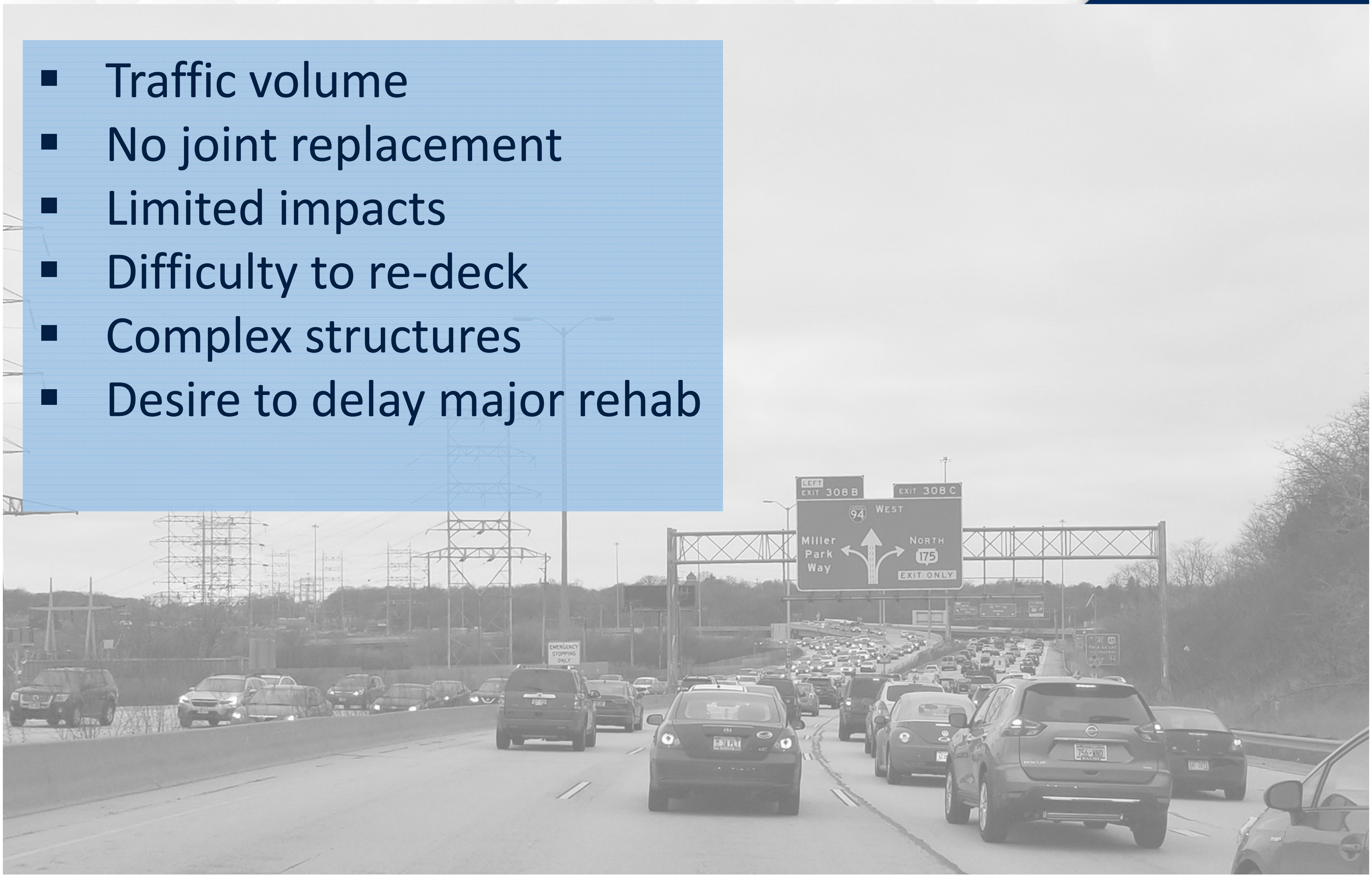


- Sawcut and replace
- Methacrylate sealer to fill cracks

Driving Factors for Utilizing PPC

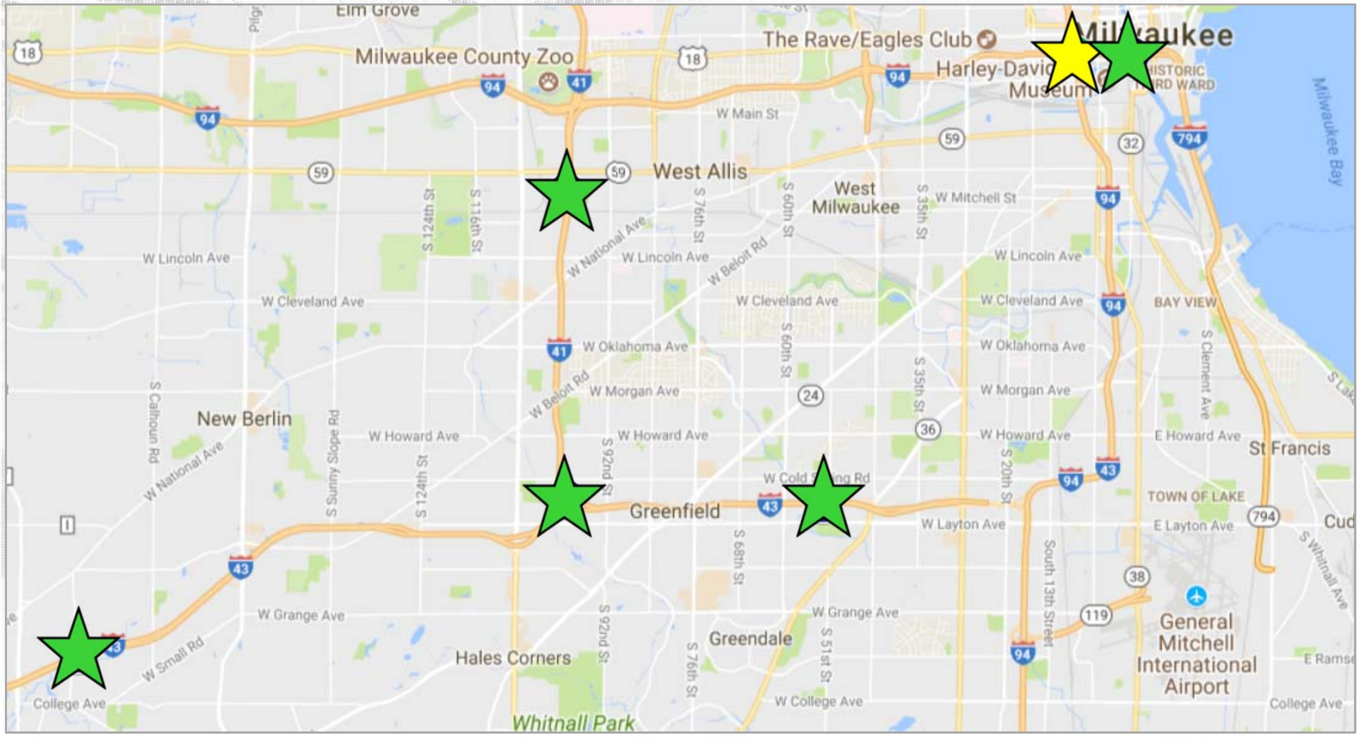
Michael Baker INTERNATIONAL

- Traffic volume
- No joint replacement
- Limited impacts
- Difficulty to re-deck
- Complex structures
- Desire to delay major rehab



Conclusion

- Find the right projects!
- New WBM guidance
- On-going development



Potential Upcoming Southeast PPC Projects

Thank You!

3D Design & Modeling, BIM for Bridges and Structures

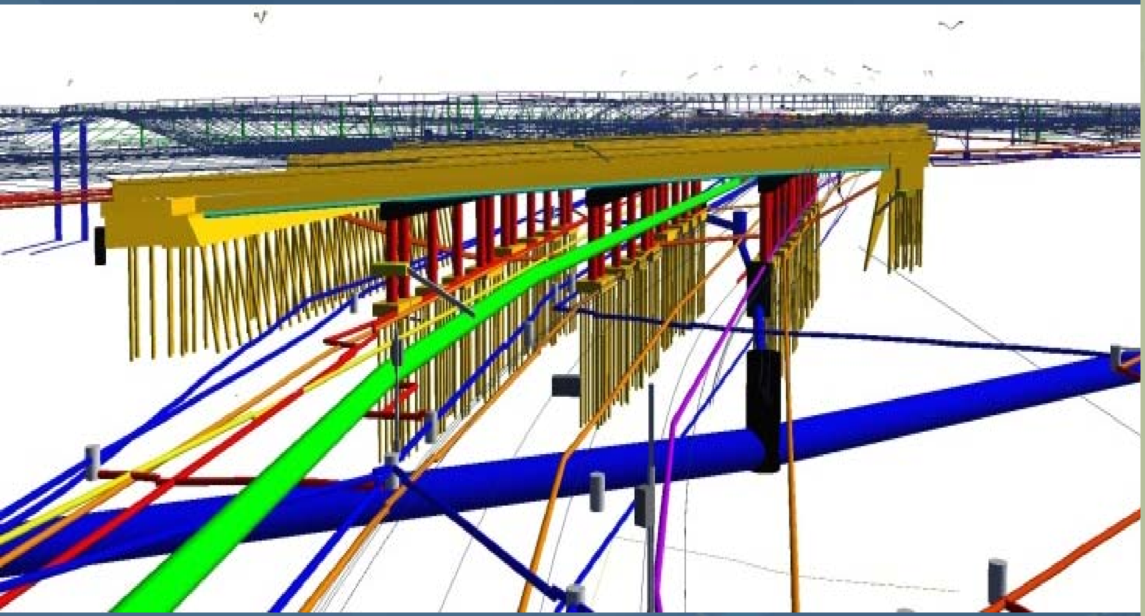
Danielle De Tennis & Adam Swierczek
BOS Structural Automation Engineer & Design Engineer

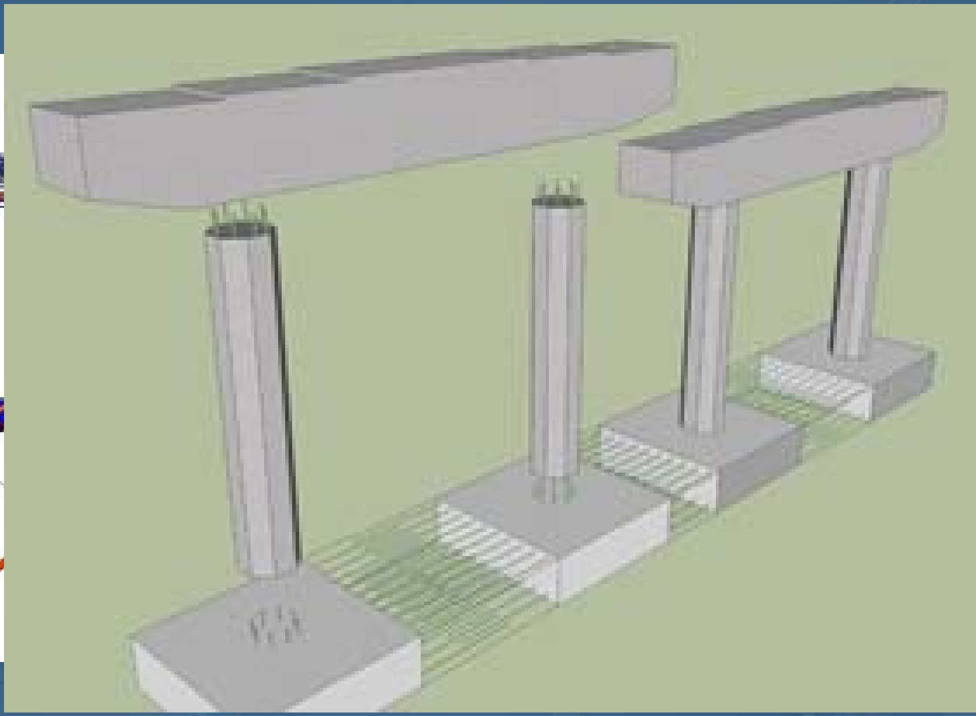
2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

May 22, 2018

BUREAU OF STRUCTURES

What is BIM for Bridges and Structures?





BUREAU OF STRUCTURES

What is our goal with BIM?

- Create an open data exchange between all involved parties for the lifecycle of the structure
  - Software-independent solutions
  - Streamline data exchanges
  - Eliminate data entry errors

BIM in BOS Design

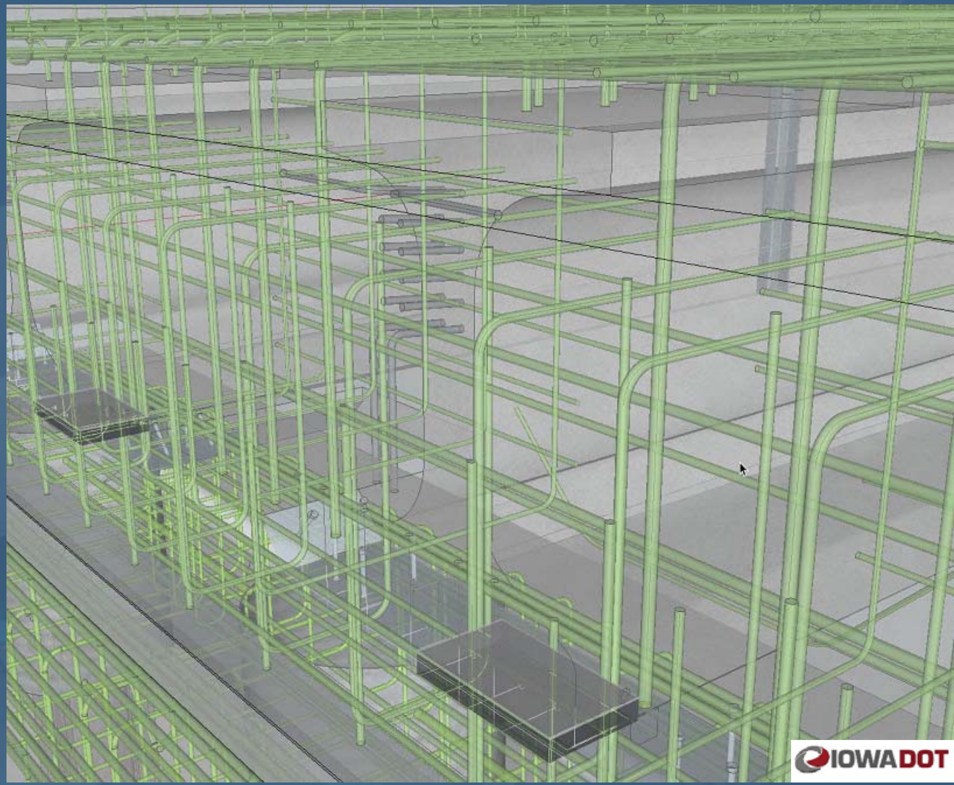
- Preliminary Design
  - Create initial approximate structure geometry
  - Improve geometry coordination with roadway

BIM in BOS Design

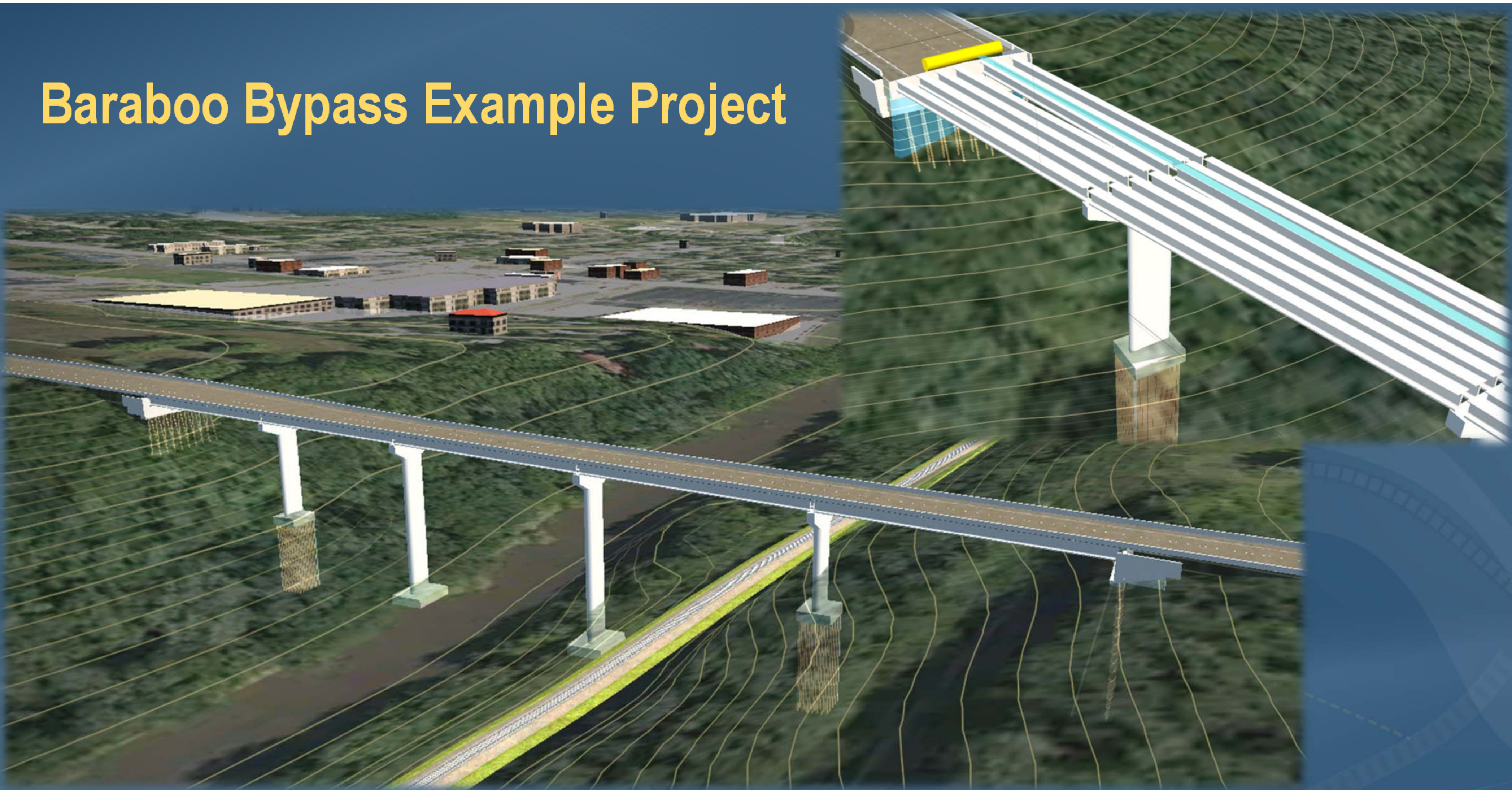
- Hydrology & Hydraulics
  - Velocity vectors/flowpaths in X and Y direction – more accurate information leads to better bridge sizing, substructure placement and skew
  - Improved accuracy of scour prediction parameters
  - LiDAR and Bathymetry are easily integrated when developing a model
  - Identify conveyance patterns not readily identifiable in 1D models
  - Easier to model complex floodplains
  - Avoid many assumptions inherent to 1D models

BIM in BOS Design

- Final Design
  - Single source of truth throughout design
  - Improve process for design iterations and late design changes
  - Improve spatial awareness of structural components
  - Streamline quantity takeoffs



Baraboo Bypass Example Project

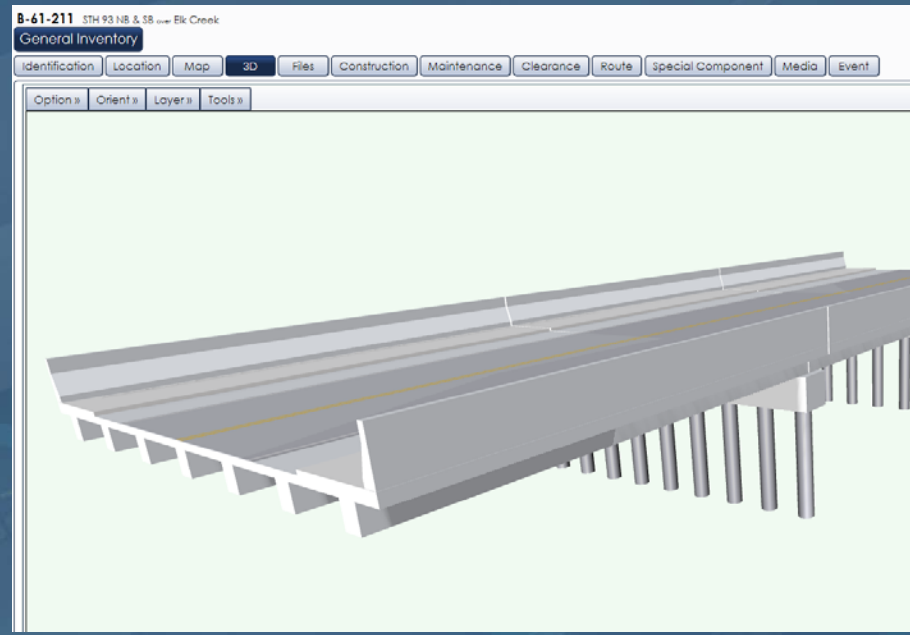


BIM in BOS Fabrication

- Move towards 3D model-based shop drawing submittal and review
  - Many fabricators already create 3D models to generate 2D shop drawings Generating and fixing up these plans take up a lot of time.
  - They are looking into ways to eliminate the need for 2D plans, or move them closer to the end of the process so the plans don’t need to be regenerated so many times.
- BOS is planning a 3D Fabrication pilot project with a steel structure

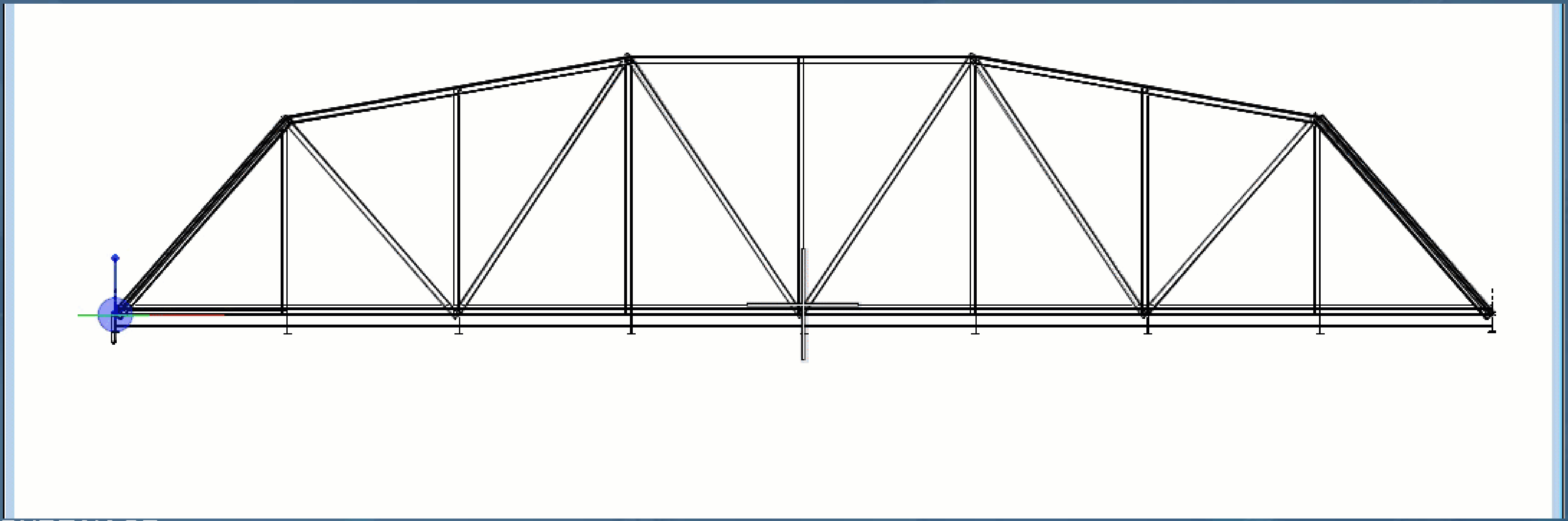
BIM in BOS Bridge Management

- Looking to add 3D models to HSI
  - Models are generated from data already entered in HSI
  - Inspectors can document defects directly on the model
  - Possibility to store design models & as-built models in the future



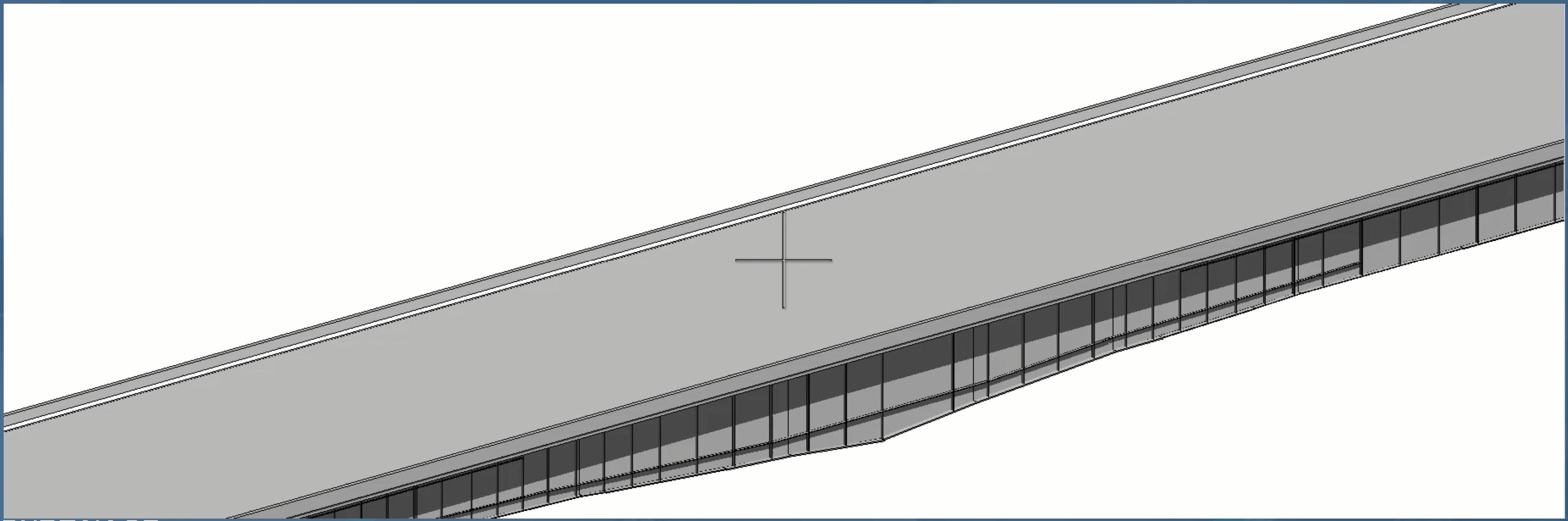
BIM in BOS Bridge Management

IFC Models Generated from AASHTOWare



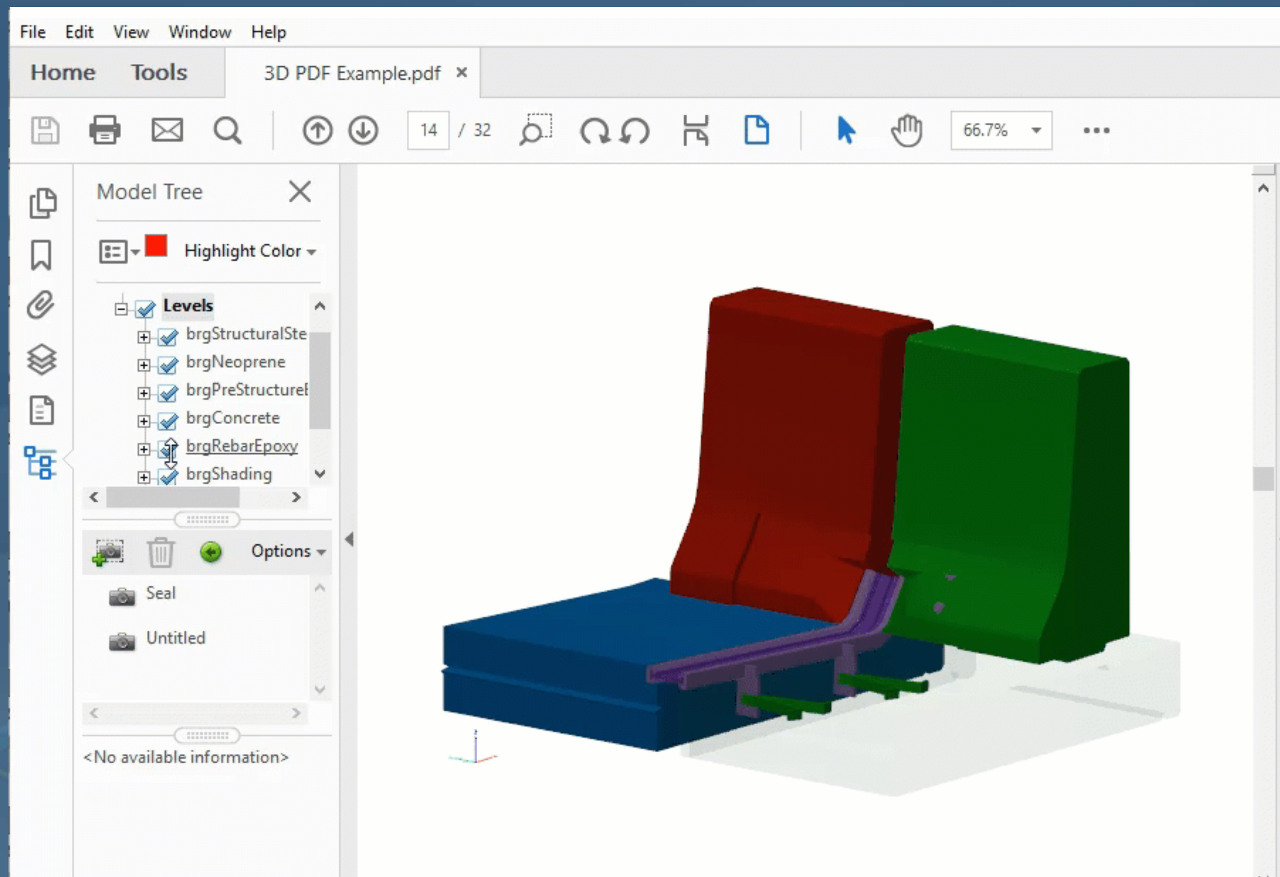
BIM in BOS Bridge Management

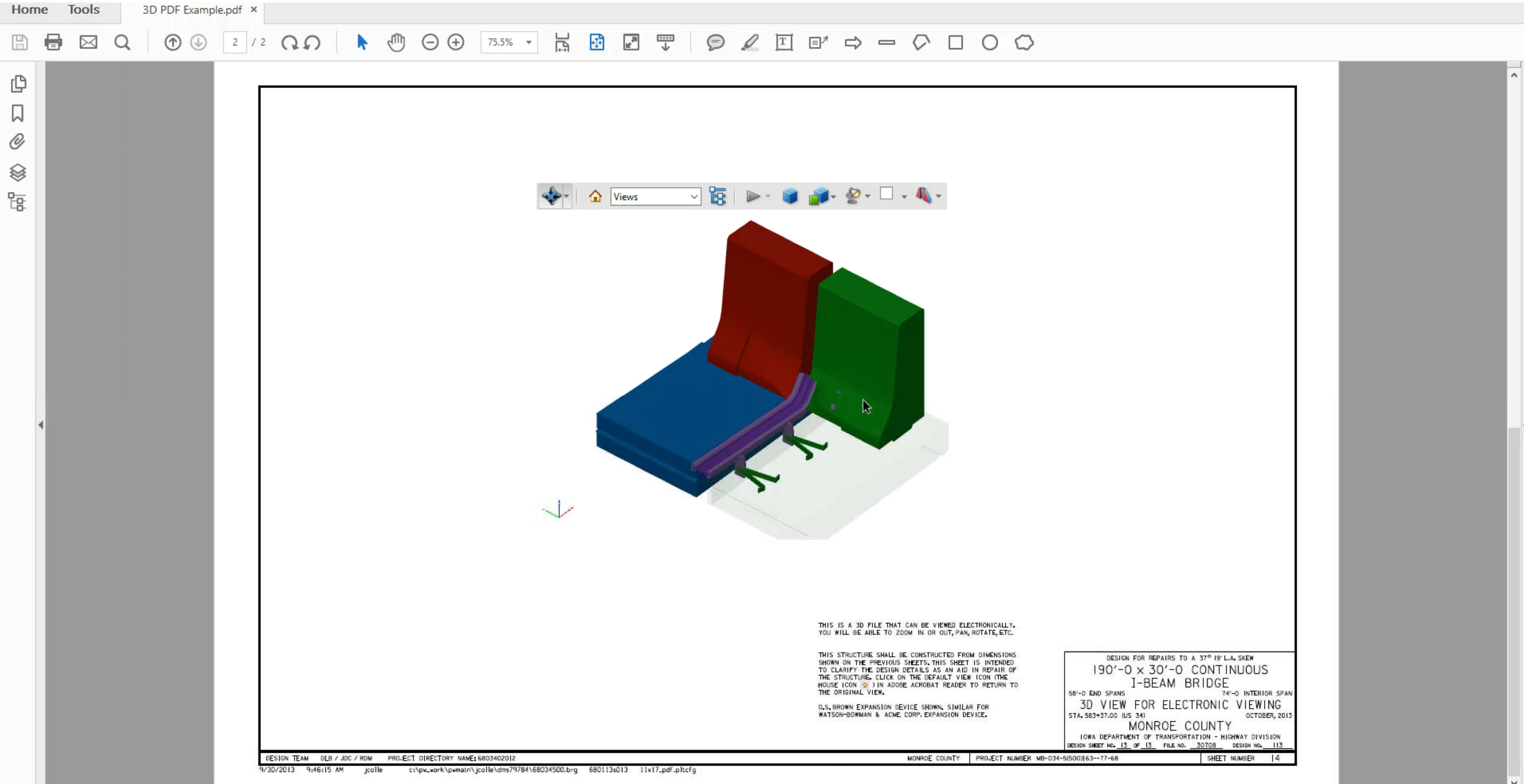
IFC Models Generated from AASHTOWare



BIM in BOS Standards

- PDF plans with 3D Details by Iowa DOT
  - We are looking to adopt 3D details in some of our Standard Details
- BIM “Insert Sheets”
  - Standard models for WisDOT PS girder shapes, etc.




Home
Tools
3D PDF Example.pdf
Views
THIS IS A 3D FILE THAT CAN BE VIEWED ELECTRONICALLY. YOU WILL BE ABLE TO ZOOM IN OR OUT, PAN, ROTATE, ETC.
THIS STRUCTURE SHALL BE CONSTRUCTED FROM DIMENSIONS SHOWN ON THE PREVIOUS SHEETS. THIS SHEET IS INTENDED TO CLARIFY THE DESIGN DETAILS AS AN AID IN REPAIR OF THE STRUCTURE. CLICK ON THE DEFAULT VIEW ICON (THE HOUSE ICON) IN ADOBE ACROBAT READER TO RETURN TO THE ORIGINAL VIEW.
D.S. BROWN EXPANSION DEVICE SHOWN. SIMILAR FOR WATSON-BOWMAN & ACME CORP. EXPANSION DEVICE.
DESIGN FOR REPAIRS TO A 37° 19' L.A. SKEW
190'-0 x 30'-0 CONTINUOUS
I-BEAM BRIDGE
58'-0 END SPANS
74'-0 INTERIOR SPAN
3D VIEW FOR ELECTRONIC VIEWING
STA. 583+37.00 (US 34)
OCTOBER, 2013
MONROE COUNTY
IOWA DEPARTMENT OF TRANSPORTATION - HIGHWAY DIVISION
DESIGN SHEET NO. 13 OF 13 FILE NO. 30708 DESIGN NO. 113
MONROE COUNTY
PROJECT NUMBER MB-034-5(500)163--77-68
SHEET NUMBER 14

IH 94 North South Project Overview

Frank Pritzlaff, P.E.

South/Central Segment Design Project Manager

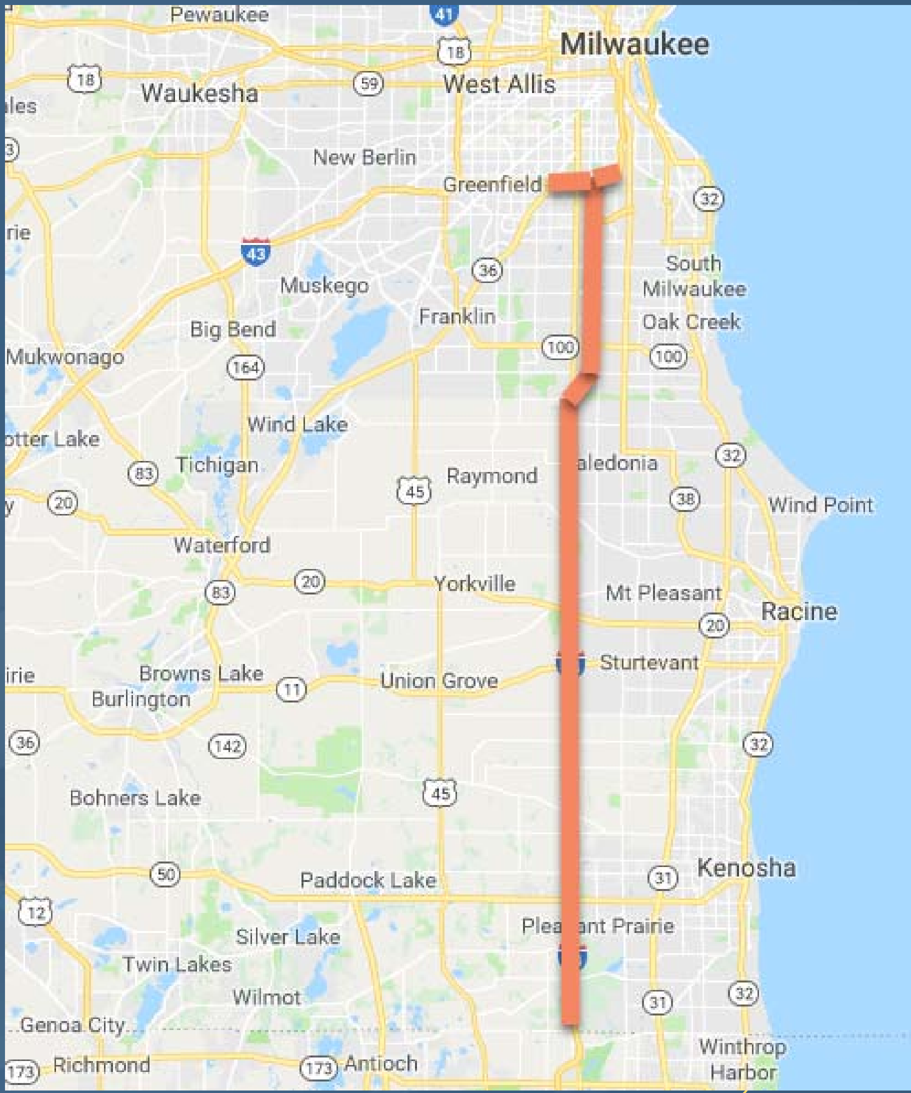
2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

May 22, 2018

BUREAU OF STRUCTURES

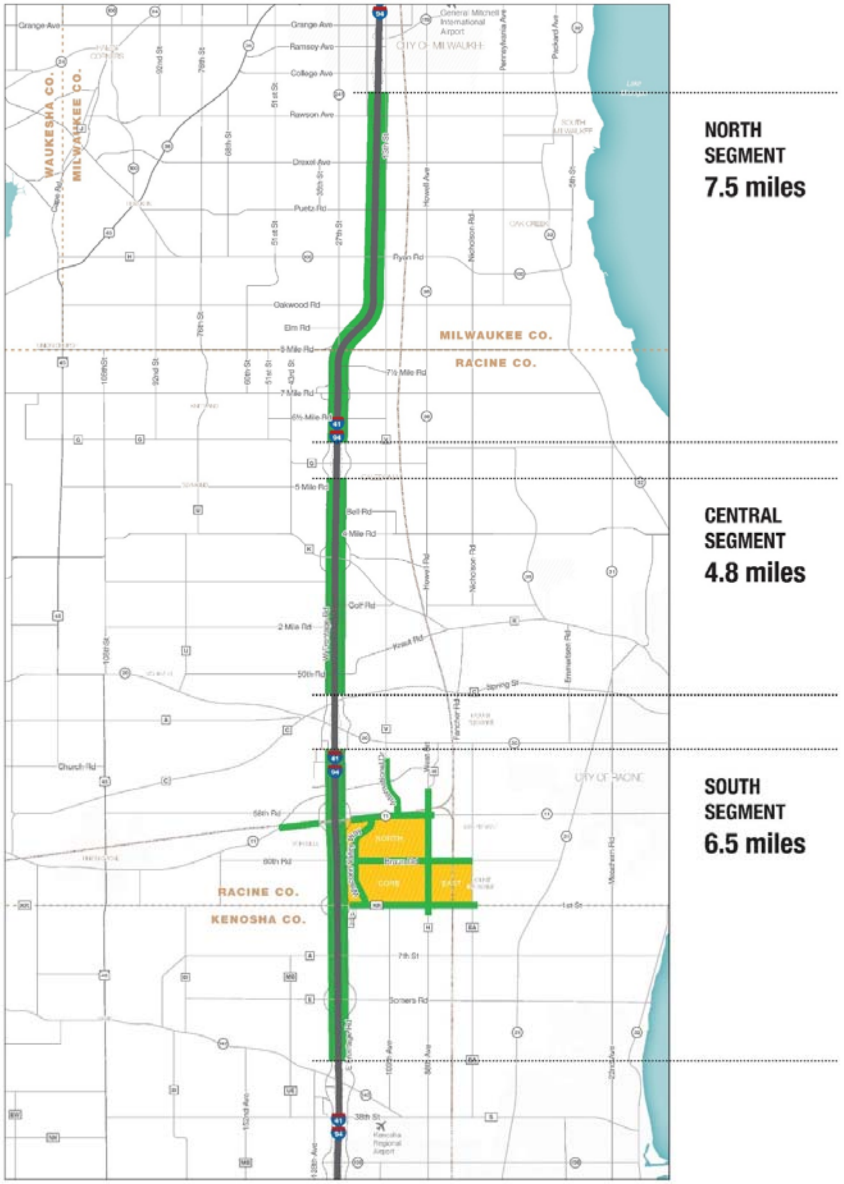
IH 94 North South Program Overview

- Current Scope of Work
  - Approximately 19 Miles of Reconstruction in 3 Counties under Accelerated Schedule
- Quantity Highlights
- Staging Concept
- Unique Roadway Elements



IH 94 North South Scope of Work - State

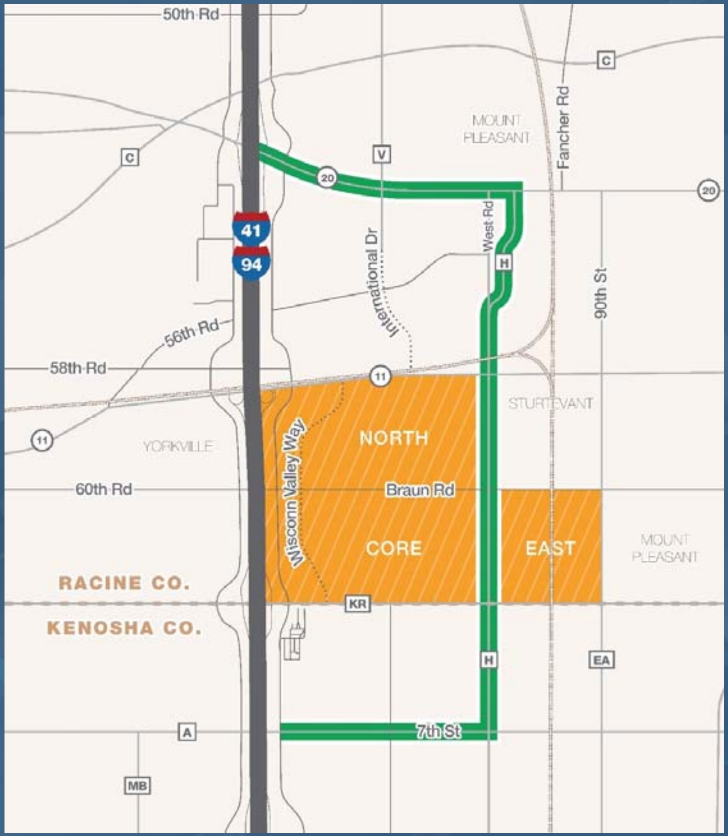
- Work Zone Prep Contract
  - February 2018 Let
- South/Central Packages ($200M - $250M expected)
  - May 22, 2018 Let
- North Package ($175M - $200M expected)
  - August 2018 Let



BUREAU OF STRUCTURES

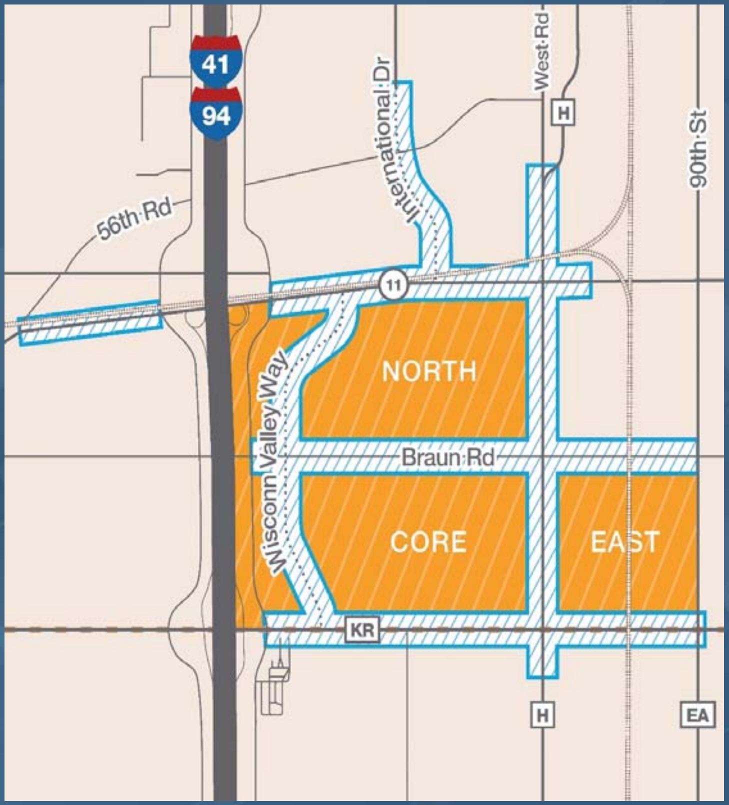
IH 94 North South
Scope of Work – Local Rehab

- STH 20
  - February 2018 Let, June 2018 Completion
- CTH H
  - March 2018 Let, June 2018 Completion
- CTH A
  - March 2018 Let, June 2018 Completion



IH 94 North South
Scope of Work – Development

- CTH KR
- CTH H
- Braun Road
- STH 11
- International Drive
- Wisconn Valley Way
  - All Construction Slated Between 2018 and 2021



BUREAU OF STRUCTURES

IH 94 North South
Quantity Highlights – South/Central Segments Only

- Common Excavation —— ~ 844,000 CY
- Roadway Embankment —— ~ 1,414,000 CY
- Base Aggregate Dense —— ~ 302,000 CY
- Select Crushed Material —— ~ 521,000 CY
- Concrete Pavement 12-Inch Special —— ~ 980,000 SY
- Bridge Deck —— ~ 76,500 SY
- Retaining Walls —— ~ 130,000 SF

IH 94 North South
Staging Concept (Accelerated)

- Two lanes in each direction (2/2 traffic)
  - 6 months 06/18 to 11/18

- Three lanes in each direction (3/3 traffic)
  - 6 months split bi-directional 12/18 to 05/19
  - 6 months bi-directional 06/19 to 11/19

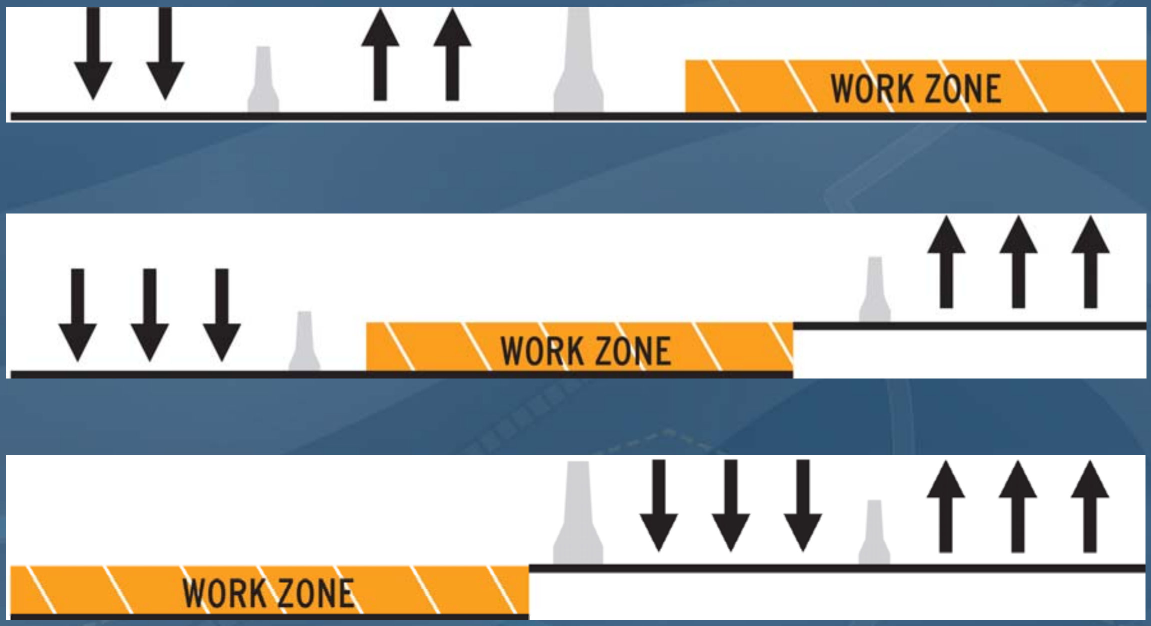
- <u>Reduces construction from 30 months to 18 months</u>

IH 94 North South
Staging Concept (Accelerated)

Stage 2: June – November 2018

Stage 3: December 2018 – May 2019

Stage 4: June – November 2019



BUREAU OF STRUCTURES

IH 94 North South
Unique Roadway Elements

- Compressed/Accelerated Construction Schedule
- Stage 3 Construction Through Winter
- Approximately 13’ Profile Grade Change at CTH KR/Braun Road
- Multiple Adjacent Public and Private Projects
  - CTH K Crossroads, IH 94 Frontage Roads, Wis 45 Rehab, Wis 20/CTH C Roundabout, Foxconn Development, etc.
- Items Left in Place from Previous Prep Contract
- On Site Batch Plant/Crushing/Staging Locations

IH 94 North South Structures

Aaron Bonk, P.E.
Bureau of Structures Design Supervisor
IH 94 NS Structures Lead

2018 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI

May 22, 2018

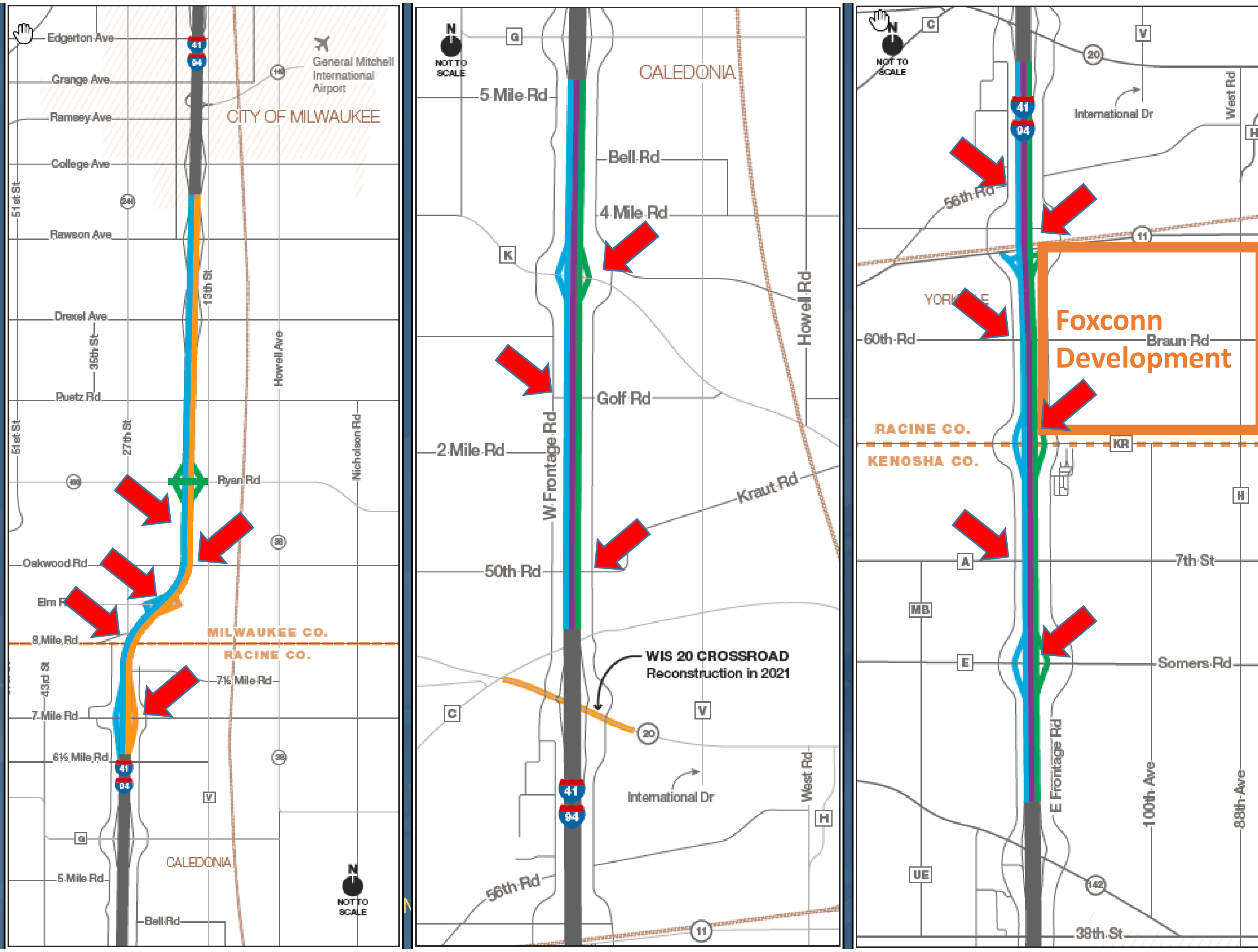
BUREAU OF STRUCTURES

IH 94 NS Structures

Project Site Overview

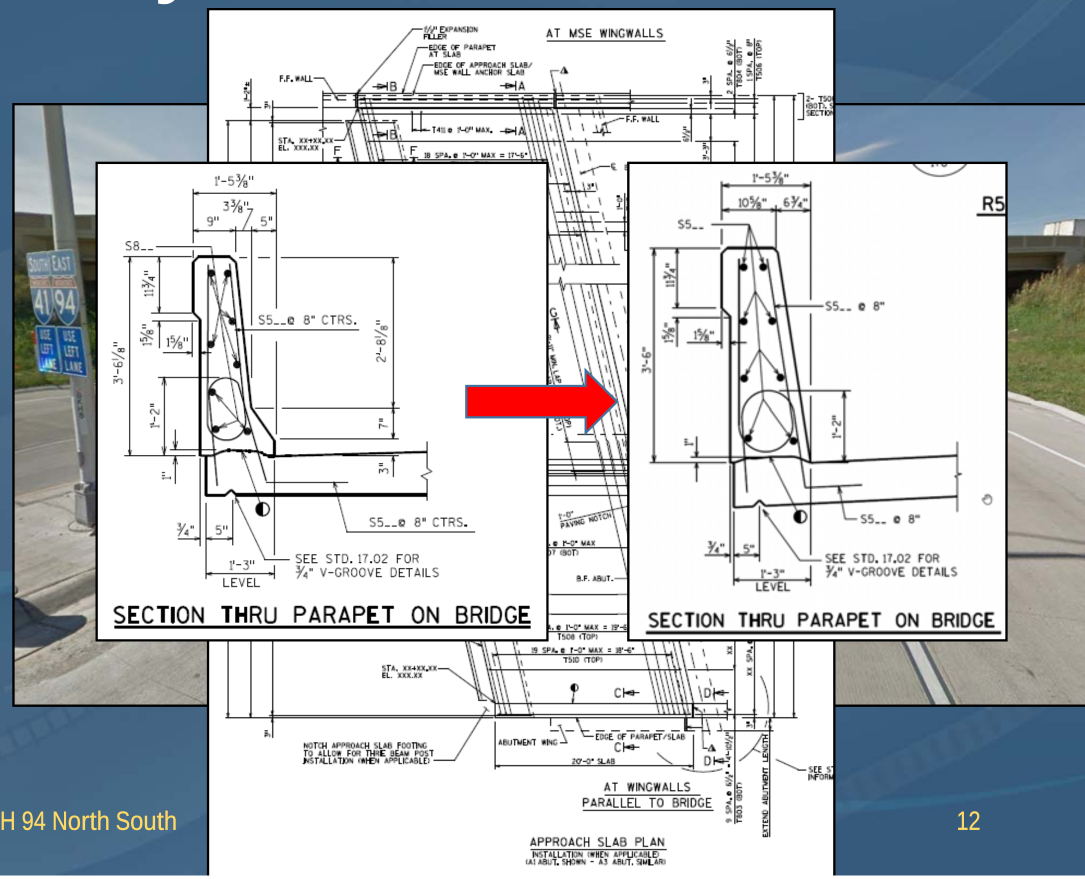
- 27 Bridges
- 17 Retaining Walls
- 46 Sign Structures

BUREAU OF STRUCTURES



IH 94 NS Structures Design Delivery Schedule

- Original designs and PS&E's in late 2000's/early 2010's
- Project restarted in 2017 with PS&E's set for early/mid 2018
  - Updates to LRFD for Racine/ Kenosha County Structures
  - Standard Updates (Structural Approach Slabs, Parapet Size/ Shape, etc.) for All Structures

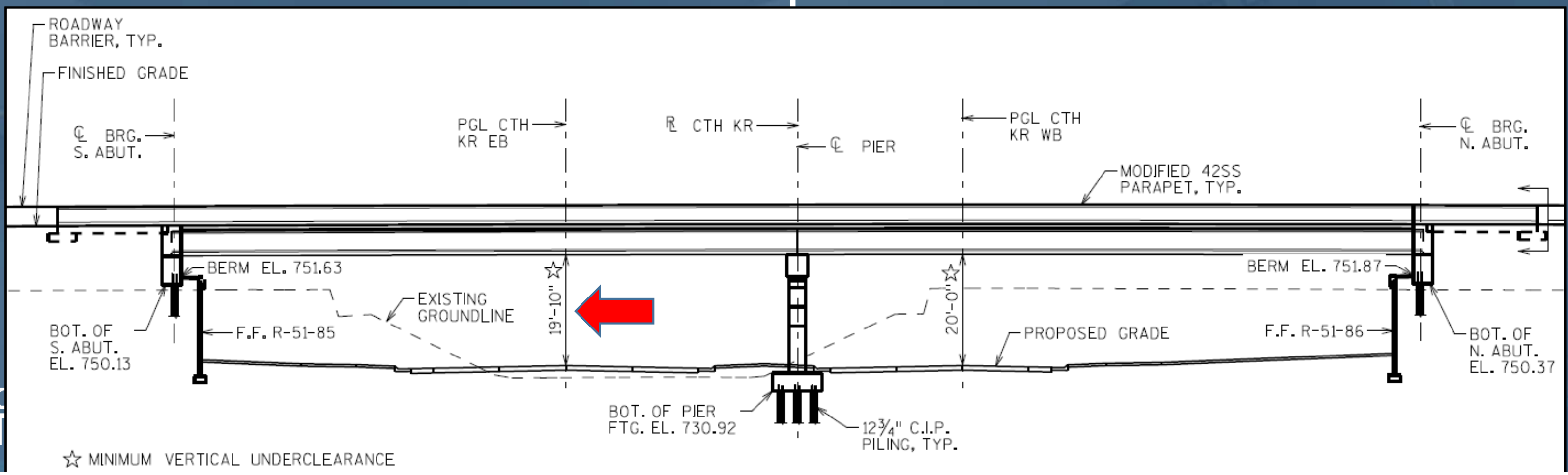


IH 94 NS Structures
Unique Aspects of Design

- Typical prestress girder and slab span bridges…
  - Except for the condensed delivery schedule and “standards” updates required
- Typical vertical underclearance requirements…
  - Except for 6m requirement near Foxconn site
- Typical pier design…
  - Except for requirement not to preclude contractor precast option
- Partial depth precast prestressed deck panels required

IH 94 NS Structures
Foxconn Area Impacts to Structures

- Full Redesign for 2 Interchanges and 2 Overpasses (14 State Structures and 10± Local Structures Impacted)
- Bridge Configurations In Flux Until Early 2018
- 6m Vertical Underclearance Requirement



BUREAU OF STRUCTURES

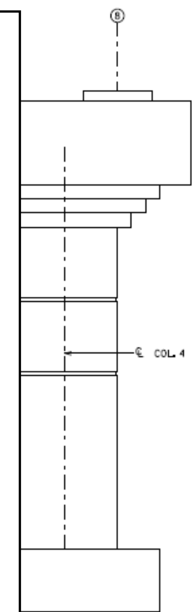
IH 94 NS Structures
Pier Design

- Construction Schedule Dictated ABC (Precast Pier) Option
- Multi-column Piers Designed as CIP, but not to Preclude Contractor Precast Option

- Chapter 7 Bridge Manual Standards

STATE PROJECT NUMBER

1030-20-16



☆ THE CONTRACTOR MAY FURNISH PRECAST CONCRETE PIER IN LIEU OF THE CAST-IN-PLACE PIER WITH THE ACCEPTANCE OF THE SHOP DRAWINGS BY THE STRUCTURES DESIGN SECTION. THE PRECAST CONCRETE PIER SHALL CONFORM TO PRECAST DETAILS IN CHAPTER 7 STANDARDS OF THE CURRENT WISCONSIN DOT BRIDGE MANUAL AND SPECIAL PROVISIONS RELATED TO PRECAST ELEMENTS WITH THE EXCEPTION OF METHOD OF PAYMENT. PAYMENT FOR THE PRECAST PIER SHALL BE BASED ON THE QUANTITIES AND PRICES BID FOR THE ITEMS LISTED IN THE "TOTAL ESTIMATED QUANTITIES" FOR THE CAST-IN-PLACE PIER.

ELEVATION CHANGES DUE TO CAST-IN-PLACE BEARING BLOCKS SHALL REQUIRE SMALL DIMENSIONAL ADJUSTMENTS TO THE COLUMNS.

◨ IF THE CONTRACTOR CHOOSES TO FURNISH PRECAST PIER MEMBERS, THE CAP HEIGHT SHALL BE 4'-0". THE REMAINING DIFFERENCE BETWEEN THE BEAM SEAT ELEVATIONS AND TOP OF 4'-0" CAP WILL BE THE "H" DIMENSION OF THE PRECAST BEARING BLOCKS. CONTRACTOR TO DETERMINE CAST-IN-PLACE BEARING BLOCK HEIGHTS. MINIMUM "H" VALUE TO BE GREATER THAT $5\frac{1}{4}$", MAXIMUM "H" VALUE TO BE LESS THAN 2'-0". ADJUST SUBSTRUCTURE ELEVATIONS TO OBTAIN MINIMUM $5\frac{1}{4}$" "H" VALUE AS NEEDED. PAYMENT FOR ANY ELEVATION ADJUSTMENT SHALL BE BASED ON THE QUANTITIES AND PRICES BID FOR THE ITEMS LISTED IN THE "TOTAL ESTIMATED QUANTITIES" FOR THE CAST-IN-PLACE PIER.

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NO.	DATE	REVISION	BY

STATE OF WISCONSIN
DEPARTMENT OF TRANSPORTATION
STRUCTURES DESIGN SECTION

STRUCTURE B-30-113

DRAWN BY ABS PLANS CK'D MJK

PRECAST PIER ALTERNATIVE

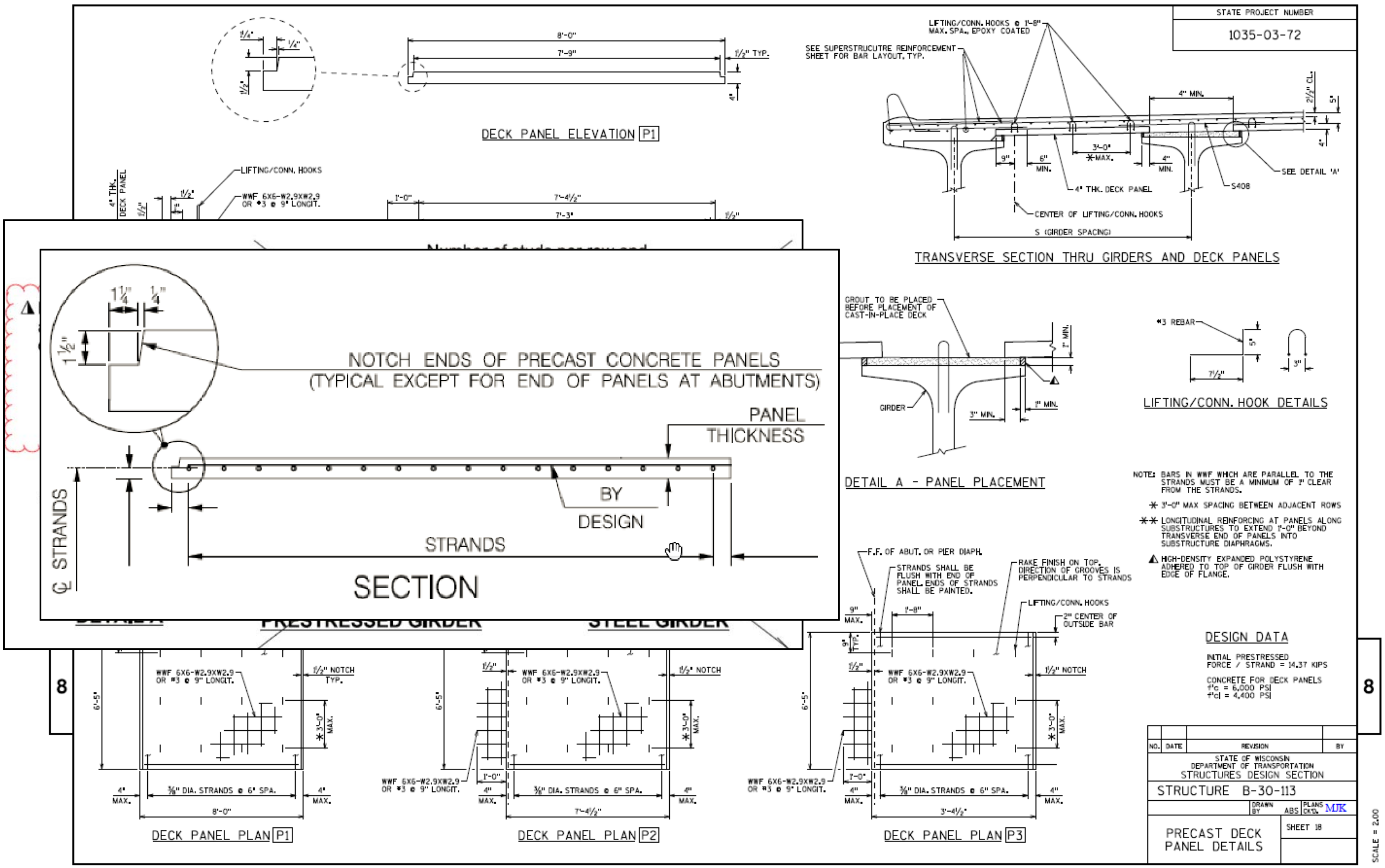
SHEET 12

SCALE = 2.50

IH 94 NS Structures
Partial Depth Precast Prestressed Deck Panels

- Construction Schedule Dictated ABC (Partial Depth Precast Prestressed Deck Panels for Girder Bridges) Requirement
- Bridges Designed to Require Panel Use

- Refined/Updated Chapter 17.10 Bridge Manual Details

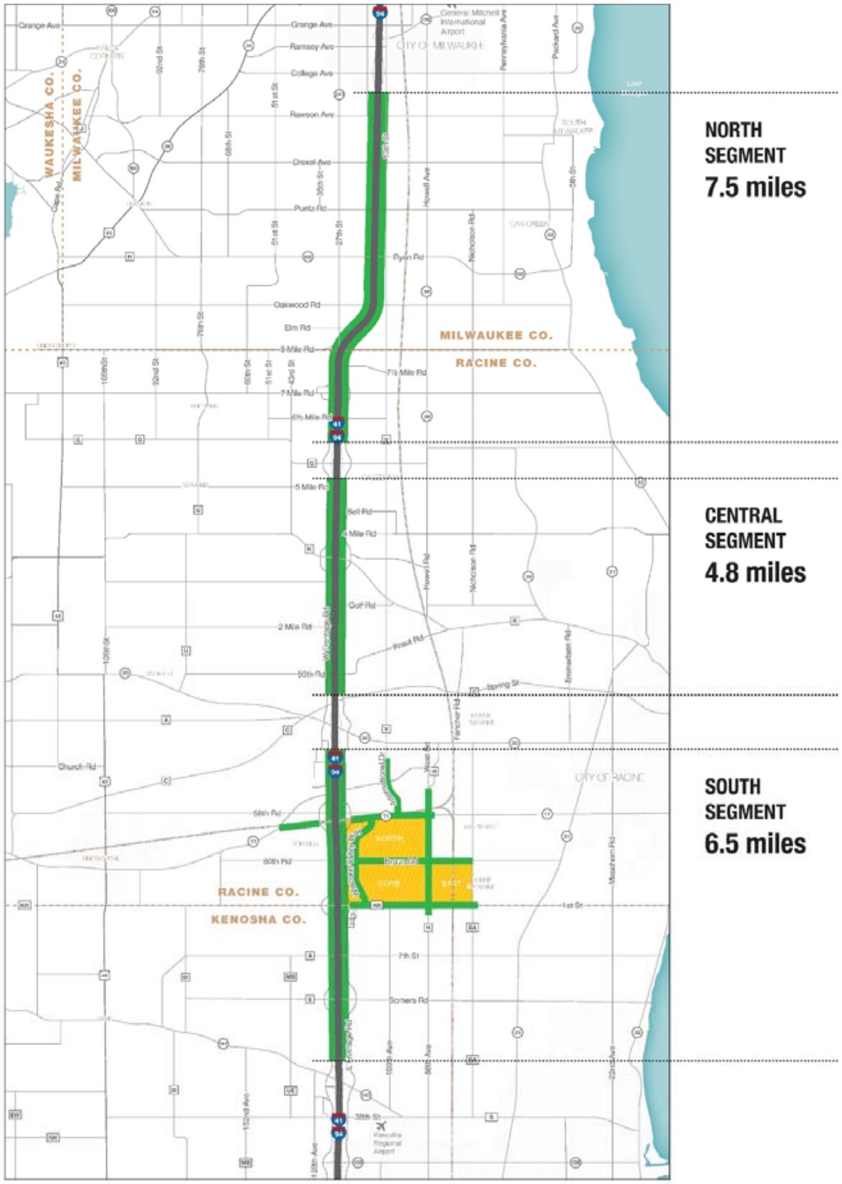


STATE PROJECT NUMBER
1035-03-72
DECK PANEL ELEVATION P1
TRANSVERSE SECTION THRU GIRDERS AND DECK PANELS
NOTCH ENDS OF PRECAST CONCRETE PANELS
(TYPICAL EXCEPT FOR END OF PANELS AT ABUTMENTS)
PANEL THICKNESS
BY DESIGN
STRANDS
℄ STRANDS
SECTION
DETAIL A - PANEL PLACEMENT
LIFTING/CONN. HOOK DETAILS
DESIGN DATA
DECK PANEL PLAN P1
DECK PANEL PLAN P2
DECK PANEL PLAN P3
STATE OF WISCONSIN DEPARTMENT OF TRANSPORTATION STRUCTURES DESIGN SECTION
STRUCTURE B-30-113
PRECAST DECK PANEL DETAILS

IH 94 North South

Questions?

BUREAU OF STRUCTURES



Strengthening Program for Local Load Posted Bridges

Alex Pence
Rating Engineer – Local System

Josh Dietsche
Supervisor – Bridge Rating/Management Unit

WisDOT Structural Engineers Symposium
Madison, WI

BUREAU OF STRUCTURES

May 22, 2018

Presentation Overview

- Load Postings on the Local System
  - Load Postings
  - SHV Load Posting Evaluation
- Strengthening Program
  - Program Concept
  - Overview of the Local Inventory
- BOS Efforts for Repair and Rehab
  - Assessing Candidate Bridges
  - Repair Methods

Load Postings on the Local System

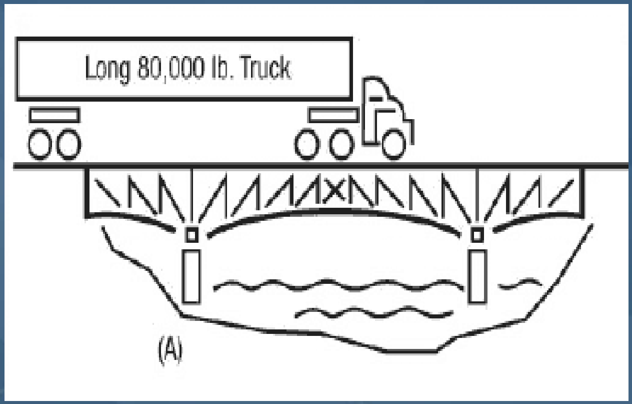
BUREAU OF STRUCTURES

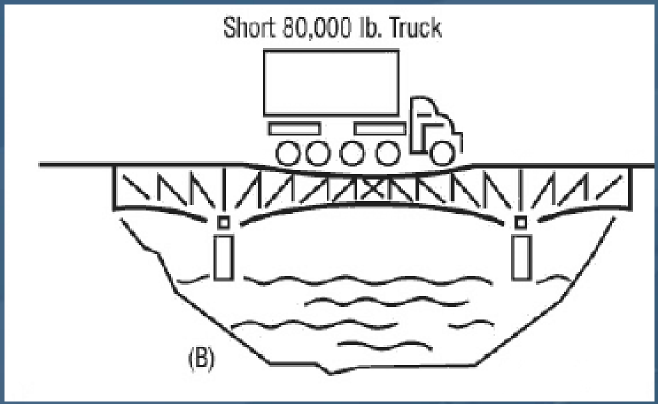
Load Postings

- Bridges are load posted when analysis shows they can no longer safely carry legal-weight traffic.
- What is "legal weight?"

Load Postings: Federal Bridge Formula

- Federal Bridge Formula (FBF) provides a standard to control spacing of truck axles/weights…to make sure the bridge was designed to support what can legally cross it.

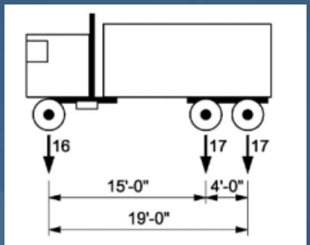




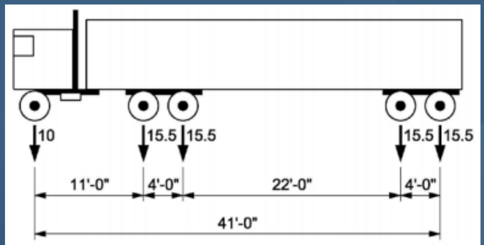
$$W = 500 * [\frac{LN}{N-1} + 12N + 36]$$

Load Postings: Posting Vehicles

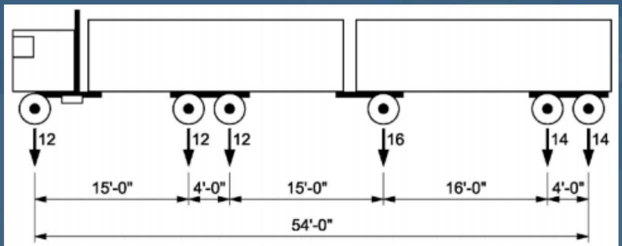
- Based on the FBF, AASHTO has an established suite of posting vehicles.



Type 3 Unit Weight = 50 Kips (25 tons)

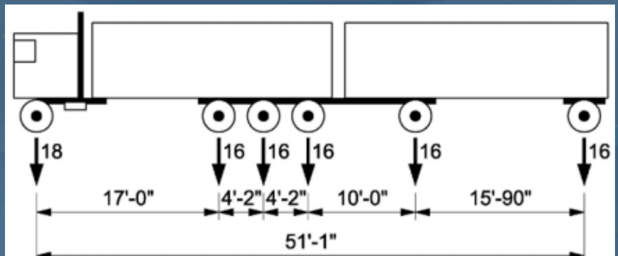


Type 3S2 Unit Weight = 72 Kips (36 tons)

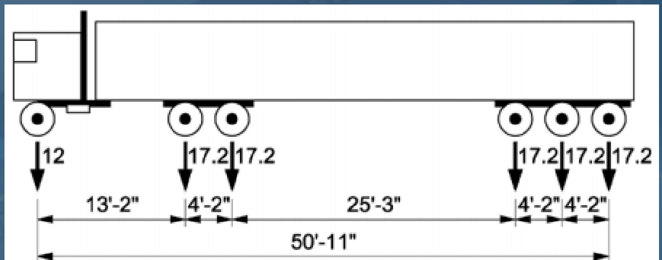


Type 3-3 Unit Weight = 80 Kips (40 tons)

- Wisconsin has two state-specific posting vehicles.



PUP Unit Weight = 98 Kips (49 tons)

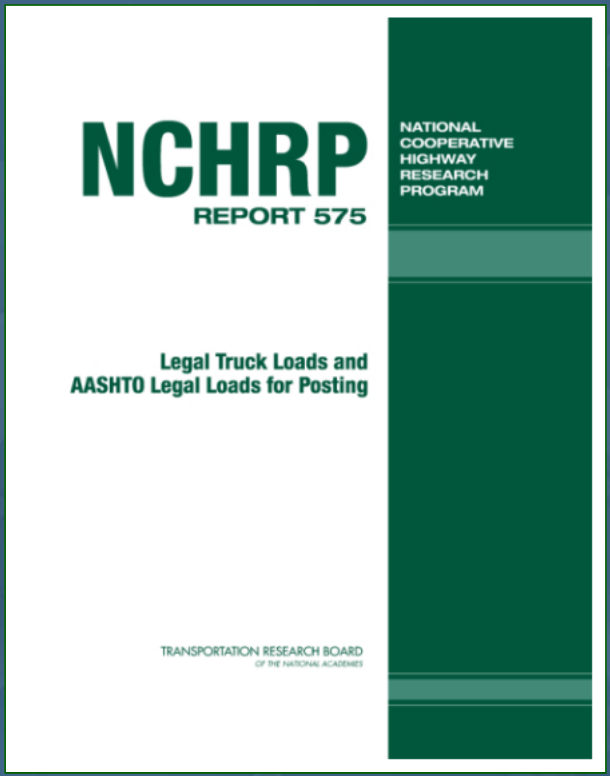


Semi Unit Weight = 98 Kips (49 tons)

- If/when a bridge can no longer carry legal-weight traffic…

SHV Load Posting Evaluation

- FHWA has mandated that states incorporate SHVs into their posting analysis by December 31, 2017
- Why are SHVs an issue?
  - Legal-weight…
  - …but exceed intended limits of the FBF
- What are SHVs?



SHV Load Posting Evaluation: Load Models

SHV Load Posting Evaluation: Results

- So what was the outcome?
  - Some new postings
  - Some lower load postings

Posting Level	Local-Owned	
	Current	w/ SHV
40 ton or greater	372	281
35 ton	52	34
30 ton	11	44
25 ton	17	139
20 ton	100	146
15 ton	110	131
10 ton	71	73
5 ton	34	39
Less than 5 ton	6	6
TOTAL:	773	893

Strengthening Program for Local Load-Posted Structures

BUREAU OF STRUCTURES

Strengthening Program: Overall Concepts

- The SHV evaluation effort highlighted load posting on the local system
- Load postings are implemented for safety purposes…
  - …but they restrict the flow of freight
- With support of WisDOT upper management, BOS looks for methods to eliminate postings, when possible
- Strengthening Program For Local Load Posting Structures

Strengthening Program: Overall Concepts

- Work with local owners to implement cost-effective, stream-lined process to repair bridges and remove postings
- BOS to provide engineering and oversight for repairs
- Use local crews (with assistance from WisDOT) to perform repairs

Overview of the Local Bridge Inventory

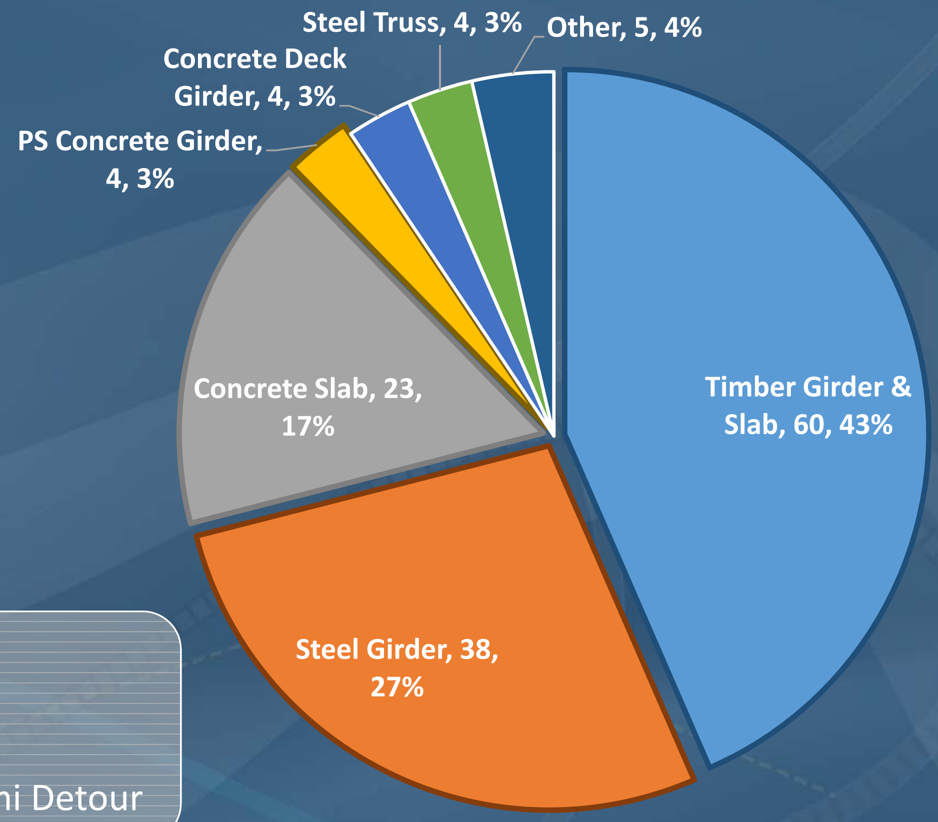
- The local system is…different…than the state system.
  - Generally older
  - Generally much lower ADT
  - Much higher percentage of single-span
  - More variety of superstructure types
    - Timber
    - Concrete T-girder
    - PS Channel
    - Other…

BOS Efforts for Repair and Rehab

BUREAU OF STRUCTURES

BOS Efforts for Repair and Rehab

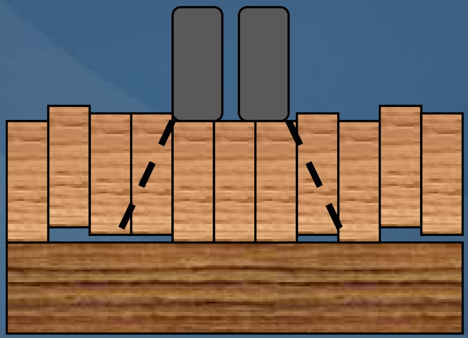
- Want to target "high value" bridges – important for freight & commerce
- Consider life remaining condition
- Not every repair option is feasible for every bridge
- Need to review individually

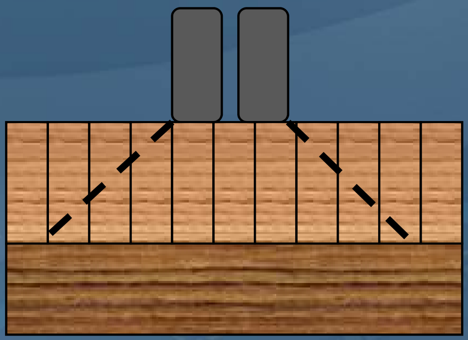


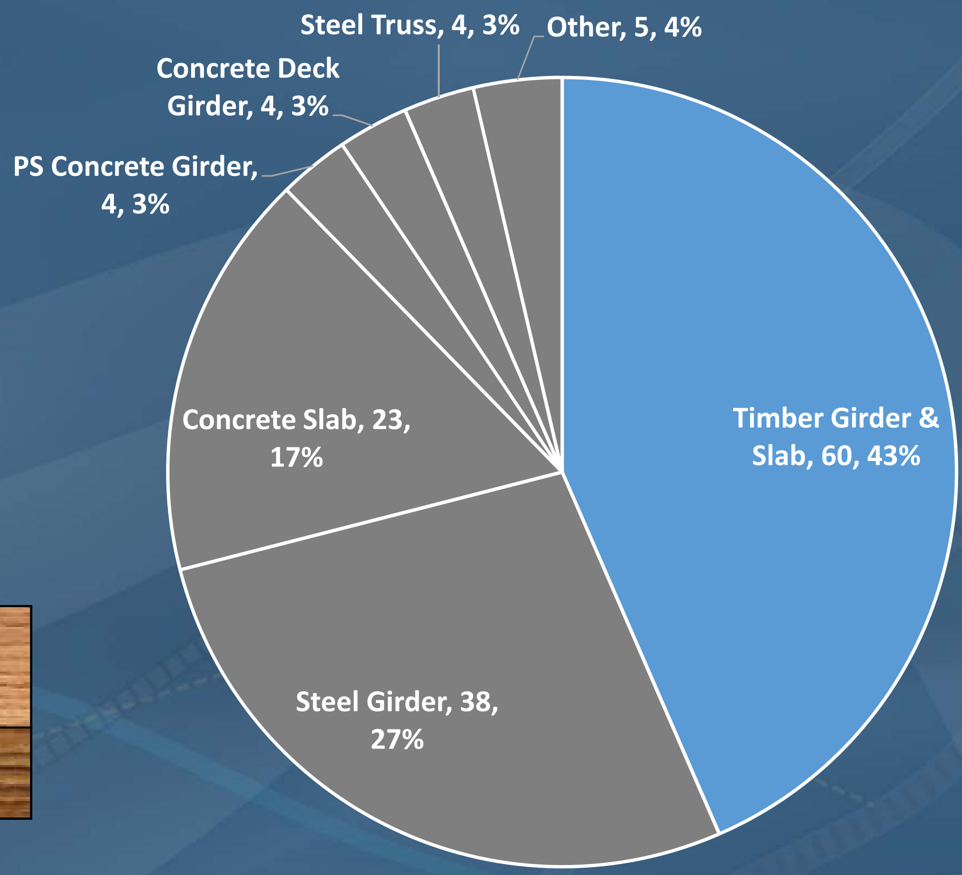
Best Candidates screening group:
- Posting < 40 TON
- All NBI Conditions 5+
- ADT 100+ *or* ADT<100 w/ 10+ mi Detour

BOS Efforts for Repair and Rehab

- Timber Slab Bridges
  - Wheel Load Distribution

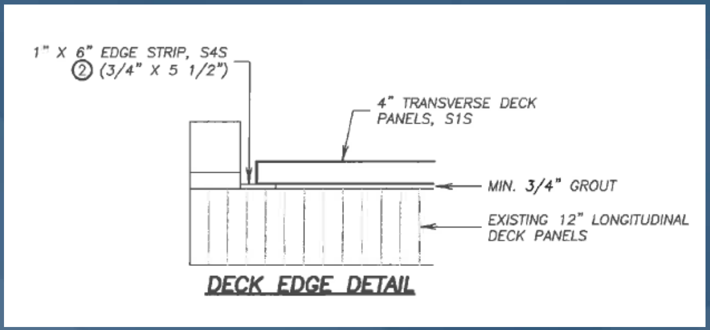


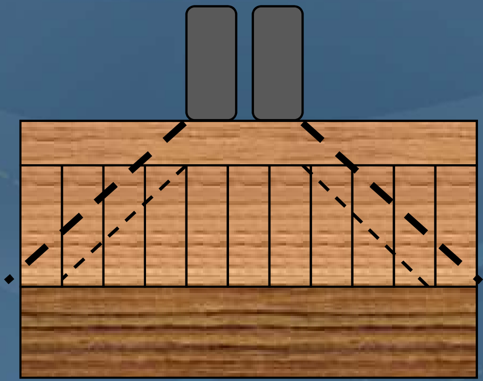


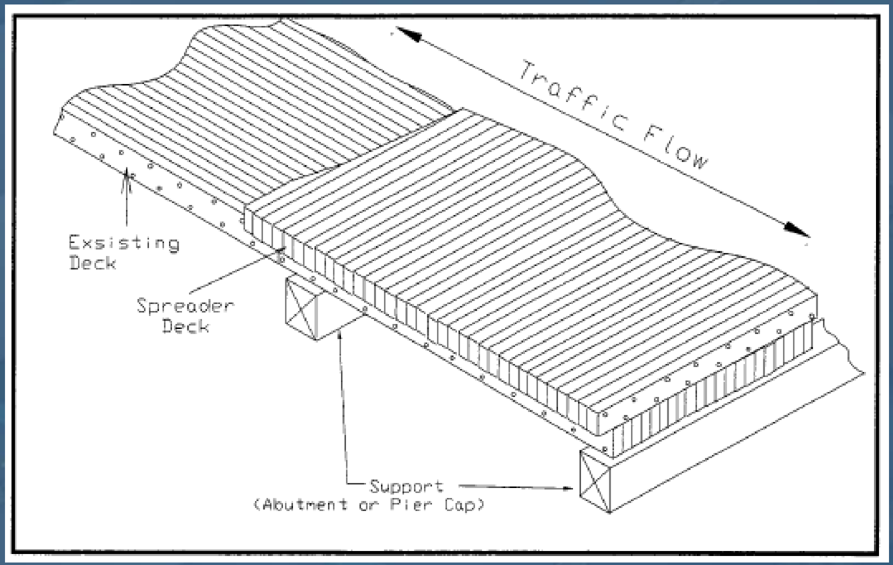


BOS Efforts for Repair and Rehab

- Timber Slab "Spreader Deck"

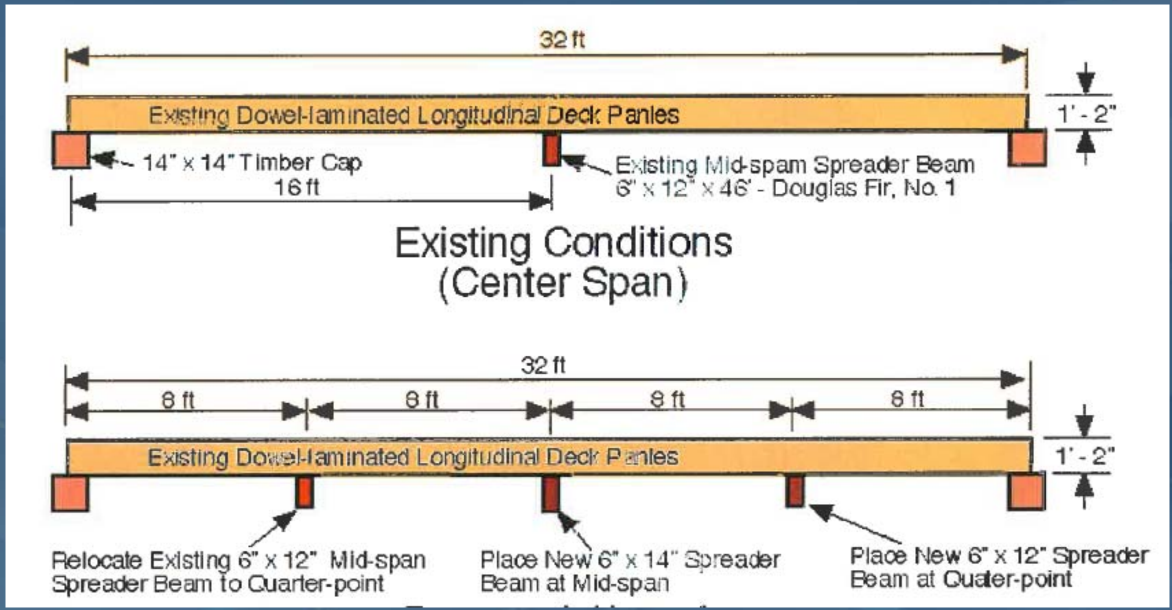






BOS Efforts for Repair and Rehab

- Timber Slab – Reduce overburden and add stiffener beams

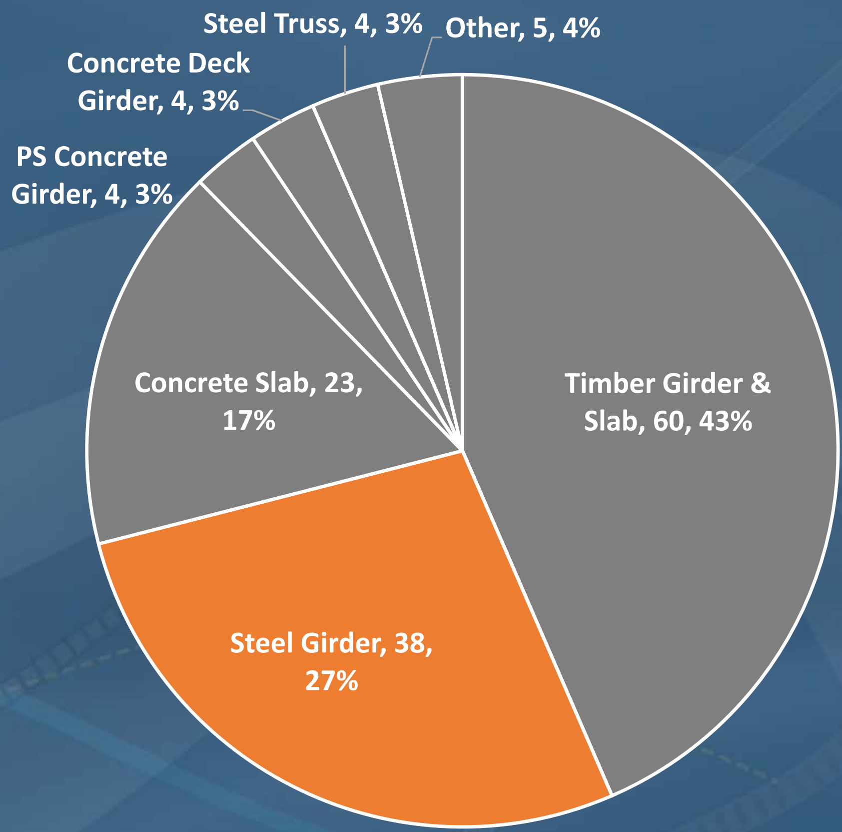


BOS Efforts for Repair and Rehab

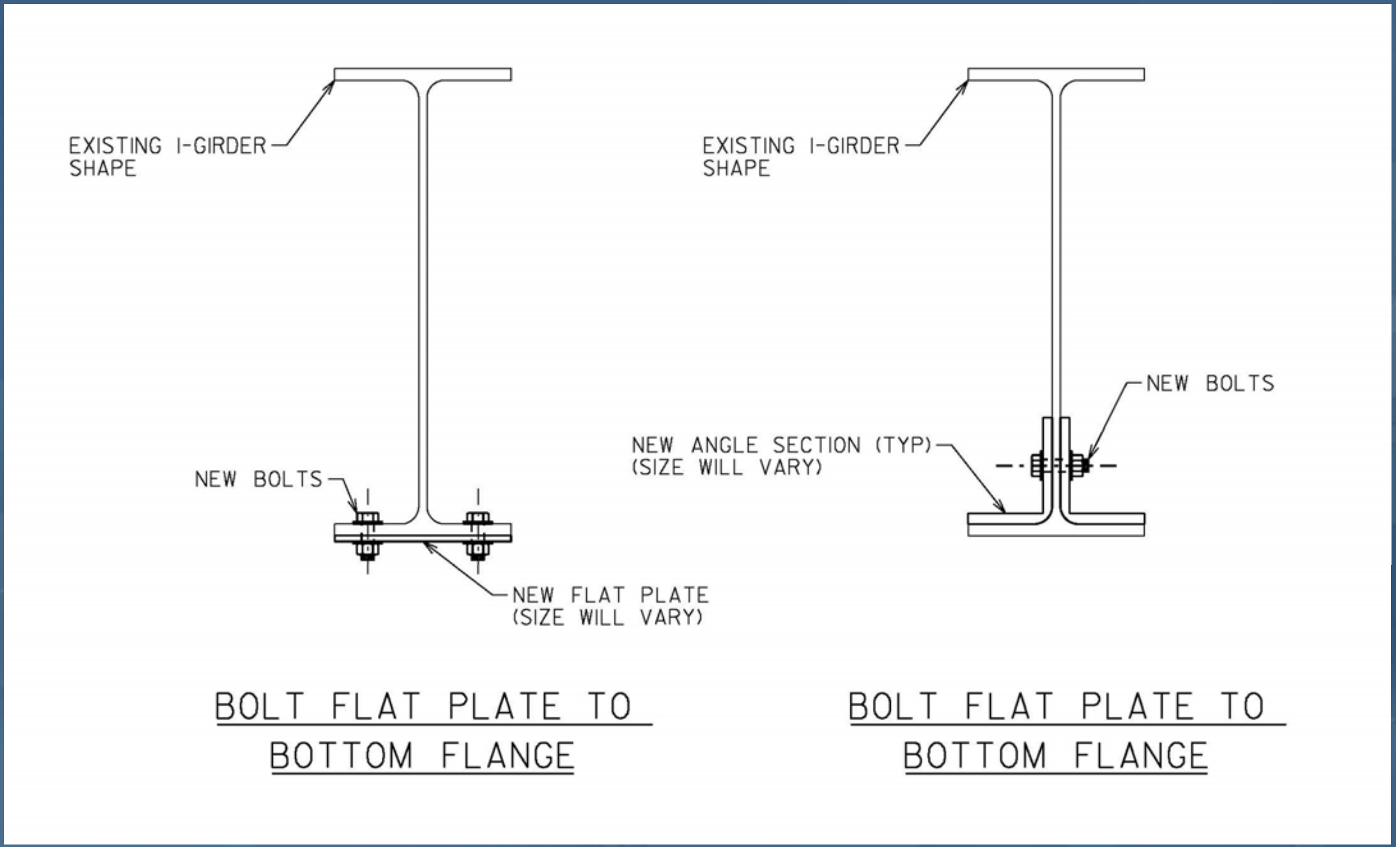
- Bolt additional steel section to existing members
  - Can often be done by state or local crews
  - Relatively inexpensive

P-16-47 | CTH B over Balsam Creek in Douglas County

Iowa DOT



BOS Efforts for Repair and Rehab



BOS Efforts for Repair and Rehab

- Make girder composite with slab
  - Several installation options available; would be site dependent
  - Girders assumed to be non-composite if plans are not available
  - First step- field verify if studs already exist

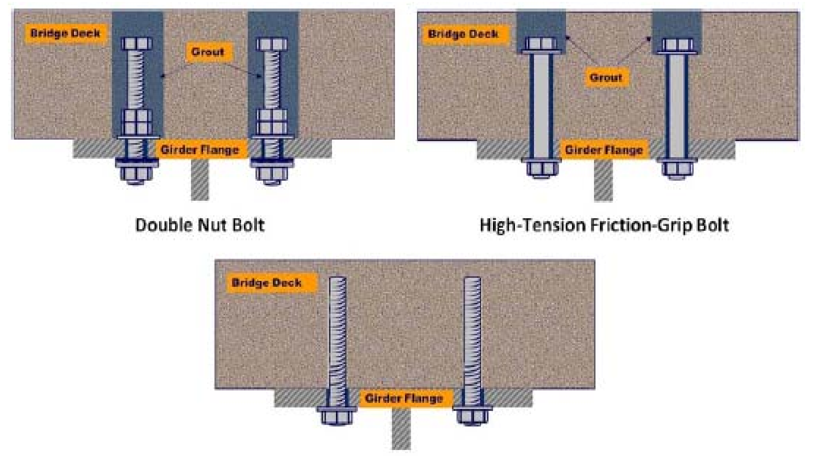
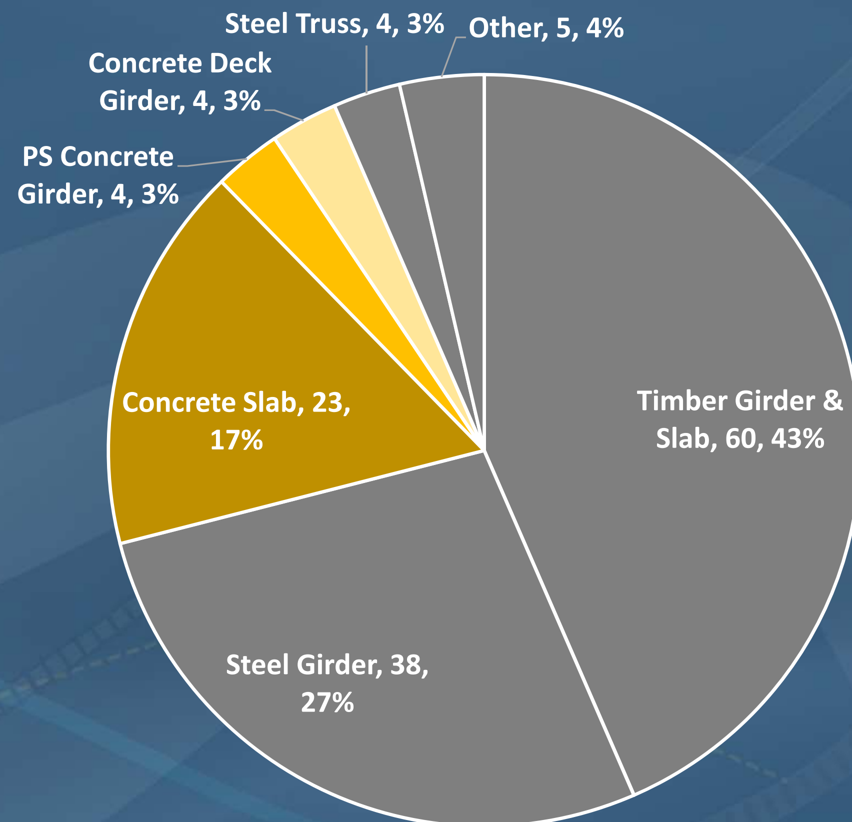


Figure 1.2 Post-Installed Shear Connectors Recommended by Kwon et al. (2009)

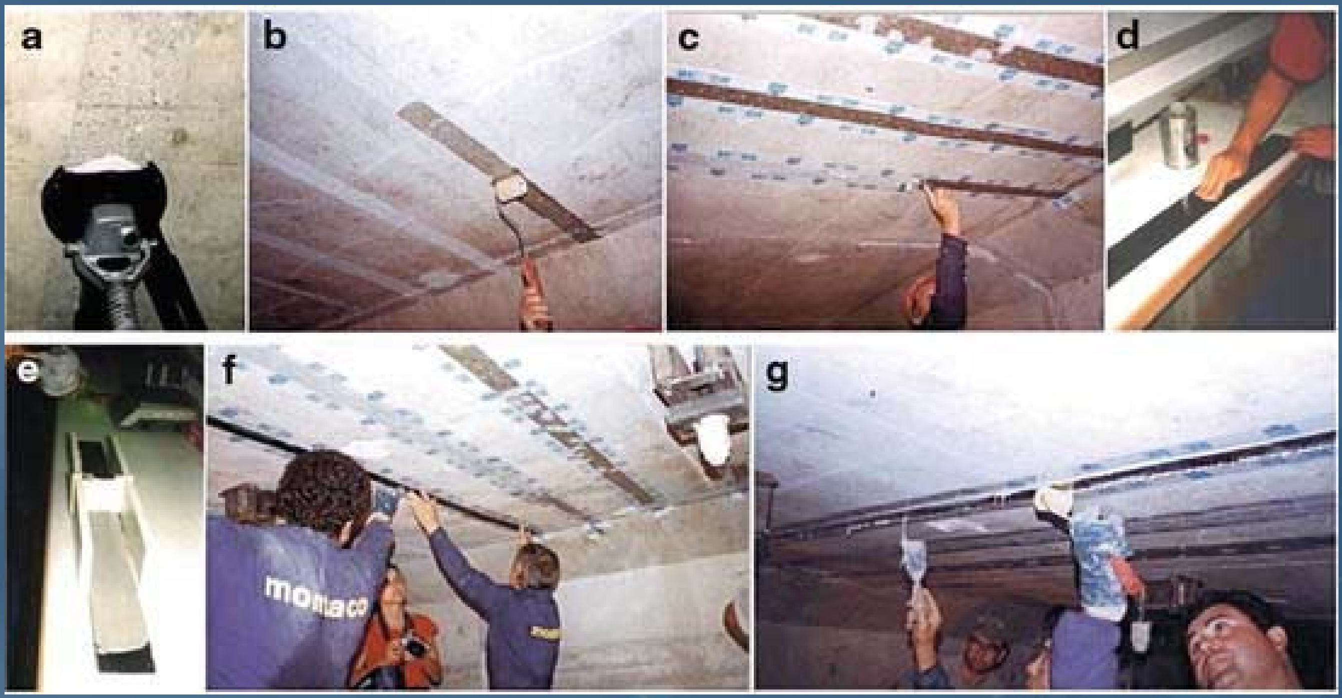
BOS Efforts for Repair and Rehab

- Concrete bridges
  - Add rebar
  - Add FRP

Arizona DOT



BOS Efforts for Repair and Rehab



A. Surface Preparation

B. Priming and Filling Voids

C. Locate Strips/Check Surface

D. Clean and Prepare FRP Strips

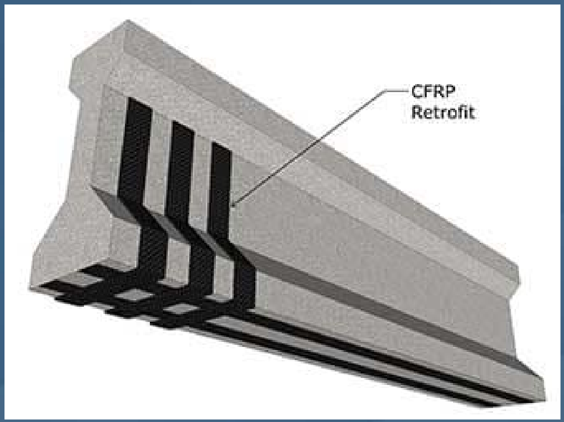
E. Coat Strips with Epoxy

F. Place Strips

G. Roll Out to Ensure Total Contact

BOS Efforts for Repair and Rehab

Shear



Flexure

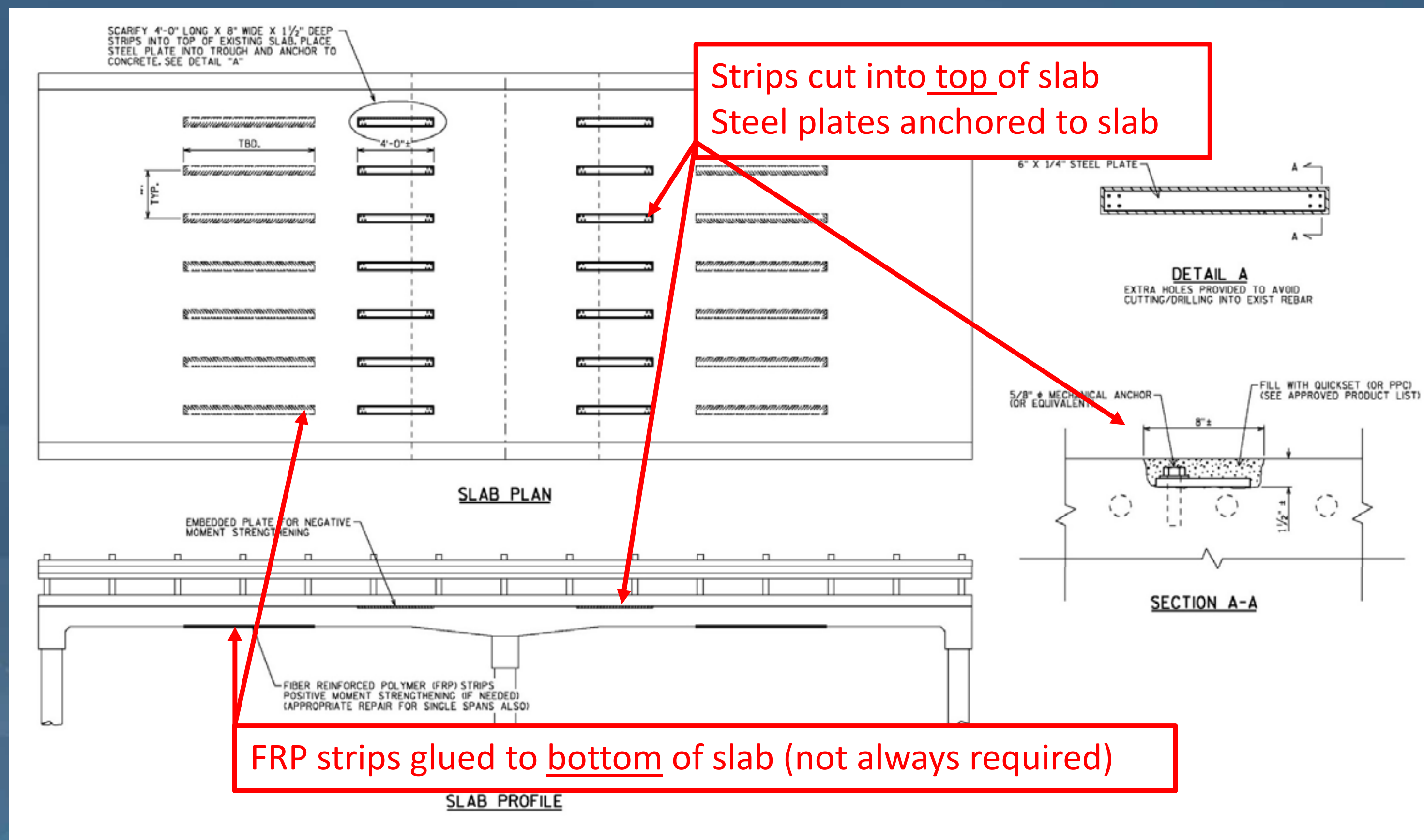
BOS Efforts for Repair and Rehab

Negative Moment

Positive Moment

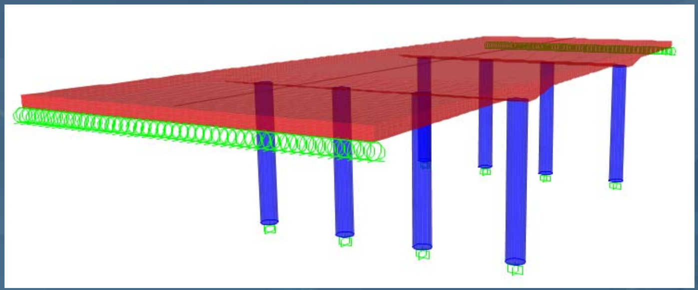
BOS Efforts for Repair and Rehab

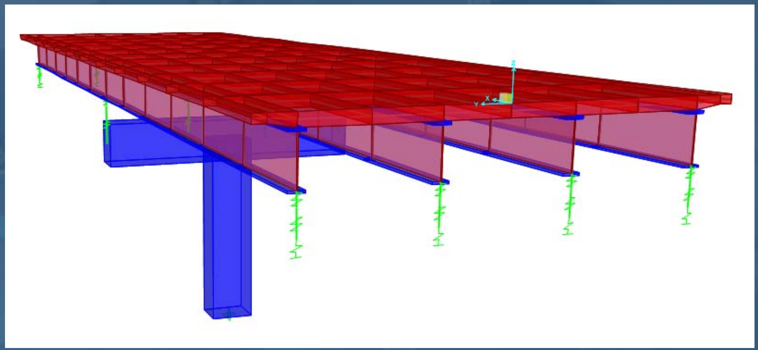
- RC slab retrofit



BOS Efforts for Repair and Rehab

- Refined analysis goes above and beyond the routine or traditional methods of analysis
- Often involves a 3D model of structure
- Takes advantage of a more true live load distribution (less simplifications)





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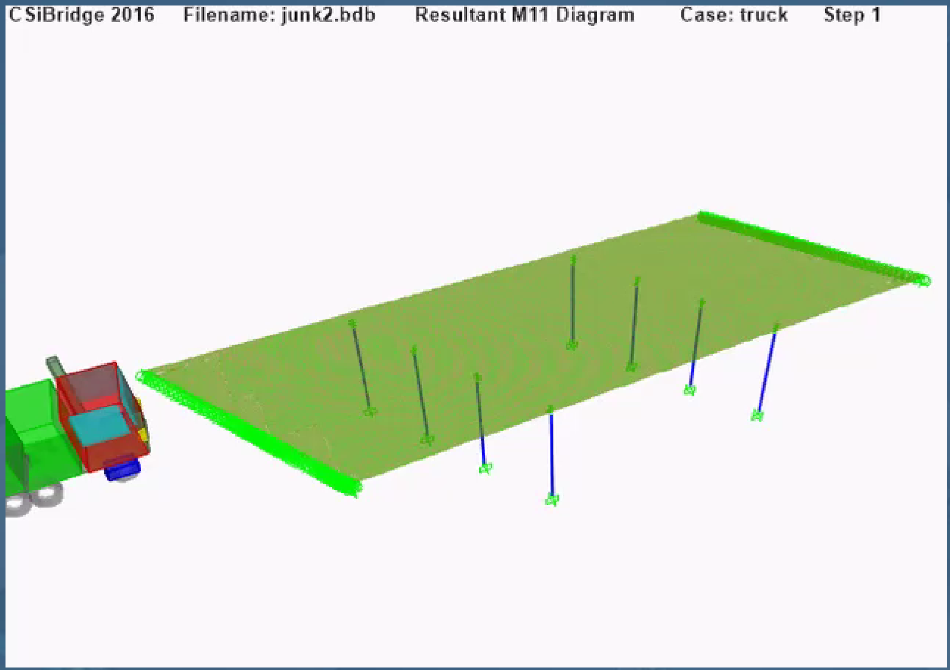
BOS Efforts for Repair and Rehab

- Enormous amounts of data
- Processing data takes most of the time
- Processing required to obtain useful information for design or load rating purposes
- Requires more judgment, assumptions; less conservative



BOS Efforts for Repair and Rehab

- Other options (more case-specific):
  - Removing overburden
  - Install external post-tensioning
  - Add additional substructure units
  - New deck
  - Load testing
  - Enhanced inspection for better information (NDE methods)
  - Other…

Questions?

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WisDOT Structural Engineers Symposium
Madison, WI

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